
CDC Injury Research Agenda

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Foreword

Injuries are the number-one killer of children and young adults in the United States. They are the leading cause of years of potential life lost before age 65. More than 5 million people in the U.S. report suffering from chronic, injury-related disabilities, and the lives of millions of others have been dramatically affected by injuries to themselves or someone they love.

These statistics are staggering. Our goal at the National Center for Injury Prevention and Control—CDC’s Injury Center—is to reduce injuries and their resulting deaths and disabilities. We have made a lot of progress, but there is still much to learn and much work to do. Research is needed to provide valuable knowledge for the injury field and to inform our prevention efforts.

In December 2000, the Injury Center embarked on an 18-month process to develop an agenda to guide our research. The agenda articulates our highest priorities—those research questions that we *must* answer to fulfill our public health responsibilities.

The research agenda focuses on answering questions that will have a relatively rapid impact on how we prevent injuries and reduce their consequences. Thus, many of the research issues of highest priority for this agenda relate to evaluating interventions and understanding how to ensure that effective interventions are widely used.

Many people helped develop the research agenda. Injury Center staff worked extensively—planning, writing, discussing, revising. Many individuals from a variety of organizations served on work groups, attended meetings, and reviewed documents. Under the leadership of Dr. Edward Brandt, members of the Research Agenda Steering Committee shared their own thoughtful perspectives that were extremely important in shaping the agenda. Hundreds of others took time to provide comments and participate in discussions that proved vital to the agenda-setting process. The names of individuals who were most involved in the process are listed in the acknowledgments. CDC extends a grateful thank you to all who generously gave of their knowledge, wisdom, creativity, and time.

Implementing this agenda will be challenging. The funds allocated for injury research and programs are not at all commensurate with the size of the injury problem. But investing in the priorities of this research agenda will make a difference. It will help prevent needless deaths and painful, costly injuries. We look forward to working with the injury prevention and control community to implement this agenda for a safer, healthier nation.

Sue Binder, M.D., Director
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Introduction

Background

Injuries have a substantial impact on the lives of individual Americans, their families, and society. The consequences of injuries can be extensive and wide ranging. They are physical, emotional, and financial; in the case of disabling injuries, the consequences are enduring.

The mission of the National Center for Injury Prevention and Control (Injury Center) at the Centers for Disease Control and Prevention (CDC) is to prevent premature death and disability and to reduce the human suffering and medical costs caused by injuries. To prevent injuries and minimize their consequences when they occur, the Injury Center uses the public health approach—a systematic process to:

- define the injury problem;
- identify risk and protective factors;
- develop and test prevention interventions and strategies;
- ensure widespread adoption of effective interventions and strategies.

The Injury Center is the only organization in the federal government with the responsibility to address all phases of the injury research framework—from foundational research through dissemination research—for all major causes of injury among all age groups. (The injury research framework is described on page 7.) To reach its goal of translating science into effective programs and policies, the Injury Center collaborates with other federal agencies and partners to document the incidence and impact of injuries, understand the causes, identify effective interventions, and promote their widespread adoption.

The importance of research in diminishing the problem of injuries has been described before. For example, the 1985 Institute of Medicine (IOM) report *Injury in America* concluded that supporting injury research is necessary to substantially reduce injury rates; the Injury Center's formation was, in part, a result of this IOM finding. Fourteen years later, another IOM report, *Reducing the Burden of Injury*, re-emphasized the importance of a scientific foundation for injury prevention and called on the Injury Center to work with foundations, states and communities, businesses, and other federal agencies to stimulate and facilitate

investment in injury research activities. Publishing this research agenda is a step toward that goal.

The Public Health Burden of Injury

In 1999 in the United States, nearly 150,000 people died from injuries, and 1 in 10 people experienced a nonfatal injury serious enough to require a visit to the emergency department. Injuries—including unintentional injuries, homicide, and suicide—are the leading cause of death for people ages 1 to 44 (table 1). Injury is the leading cause of years of potential life lost before age 65.

For people ages 1 to 34, unintentional injuries alone claim more lives than any other cause. In 1999, motor vehicle traffic fatalities accounted for 42% of unintentional fatal injuries, representing more than 40,000 deaths (table 2). Poisoning, suffocation, drowning, falling, and fire each accounted for a substantial proportion of unintentional injury deaths. Adverse effects in medical settings caused an additional 2,540 fatalities.

The impact of injuries resulting from violence is also great. Homicide is the second leading cause of death for people ages 15 to 24 and the third or fourth leading cause for every other group between the ages of 1 and 34. Suicide is not only the eleventh leading cause of death across all ages but ranks second for people ages 25 to 34 and third for people ages 15 to 24.

Many injuries do not result in death but nevertheless place a considerable burden on individuals and society. Approximately one third of all emergency department visits and 8% of all hospital stays are due to injuries. Data from the National Electronic Injury Surveillance System indicate that falls account for an estimated 7.43 million emergency department visits annually, or 25% of all injury visits (table 3). Another 4.95 million visits (17%) are transportation related, and 1.67 million (5.7%) result from assaults. In addition, many injuries have consequences well beyond the initial need for medical attention. For instance, it is estimated that 5.3 million people in the U.S. have long-term disabilities from traumatic brain injury and 200,000 from spinal cord injury. The topic-specific chapters that follow present more detailed data, but clearly, injuries constitute a major burden on the public's health.

Injuries—including unintentional injuries, homicide, and suicide—are the leading cause of death for people ages 1 to 44.

Table 1
10 Leading Causes of Death, United States, 1999
All Races, Both Sexes

Rank	Age Groups										All Ages
	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	
1	Congenital Anomalies 5,473	Unintentional Injury 1,898	Unintentional Injury 1,459	Unintentional Injury 1,632	Unintentional Injury 13,656	Unintentional Injury 11,890	Malignant Neoplasms 16,732	Malignant Neoplasms 46,681	Malignant Neoplasms 89,067	Heart Disease 607,265	Heart Disease 725,192
2	Short Gestation 4,392	Congenital Anomalies 549	Malignant Neoplasms 509	Malignant Neoplasms 503	Homicide 4,998	Suicide 5,106	Unintentional Injury 15,231	Heart Disease 34,994	Heart Disease 64,167	Malignant Neoplasms 390,122	Malignant Neoplasms 549,838
3	SIDS 2,648	Malignant Neoplasms 418	Congenital Anomalies 207	Homicide 246	Suicide 3,901	Homicide 4,231	Heart Disease 13,600	Unintentional Injury 11,639	Bronchitis Emphysema Asthma 11,297	Cerebro-vascular 148,599	Cerebro-vascular 167,366
4	Maternal Pregnancy Comp. 1,399	Homicide 376	Homicide 186	Suicide 242	Malignant Neoplasms 1,724	Malignant Neoplasms 4,005	Suicide 6,466	Liver Disease 6,368	Cerebro-vascular 9,652	Bronchitis Emphysema Asthma 108,112	Bronchitis Emphysema Asthma 124,181
5	Respiratory Distress 1,110	Heart Disease 183	Heart Disease 116	Congenital Anomalies 221	Heart Disease 1,069	Heart Disease 3,066	HIV 6,232	Cerebro-vascular 5,563	Diabetes Mellitus 9,097	Influenza & Pneumonia 57,282	Unintentional Injury 97,860
6	Placenta Cord Membranes 1,025	Influenza & Pneumonia 130	Benign Neoplasms 64	Heart Disease 161	Congenital Anomalies 434	HIV 2,729	Liver Disease 3,302	Suicide 5,081	Unintentional Injury 7,285	Diabetes Mellitus 51,843	Diabetes Mellitus 68,399
7	Unintentional Injury 845	Perinatal Period 92	Bronchitis Emphysema Asthma 49	Bronchitis Emphysema Asthma 90	Bronchitis Emphysema Asthma 209	Diabetes Mellitus 582	Homicide 3,206	Diabetes Mellitus 4,735	Liver Disease 5,637	Alzheimer's Disease 44,020	Influenza & Pneumonia 63,730
8	Bacterial Sepsis 691	Septicemia 87	Septicemia 47	Influenza & Pneumonia 47	HIV 198	Cerebro-vascular 580	Cerebro-vascular 2,574	HIV 3,907	Suicide 2,896	Unintentional Injury 32,219	Alzheimer's Disease 44,536
9	Circulatory System Disease 667	Benign Neoplasms 63	Influenza & Pneumonia 46	Cerebro-vascular 39	Cerebro-vascular 182	Congenital Anomalies 465	Diabetes Mellitus 1,942	Bronchitis Emphysema Asthma 3,110	Nephritis 2,864	Nephritis 29,938	Nephritis 35,525
10	Atelectasis 647	Bronchitis Emphysema Asthma 54	HIV 38	Benign Neoplasms 37	Influenza & Pneumonia 179	Liver Disease 407	Influenza & Pneumonia 1,063	Influenza & Pneumonia 1,697	Septicemia 2,714	Septicemia 24,626	Septicemia 30,680

Produced by: Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC

Data Source: National Center for Health Statistics, Vital Statistics System

Table 2
Unintentional Injury Deaths, United States, 1999
All Ages, All Races, Both Sexes

Cause of Death ^a	Number of Deaths	Percentage of Deaths
Motor vehicle traffic	40,965	41.9
Falls	13,162	13.5
Poisoning	12,186	12.5
Suffocation	5,503	5.6
Drownings ^b	3,529	3.6
Fires and burns	3,471	3.6
Natural disasters, animals, and environmental exposures	1,923	2.0
Pedestrian ^c	1,502	1.5
Struck by or against a person or object	894	0.9
Firearms	824	0.8
Machinery	622	0.6
Pedal cyclist ^c	185	0.2
Cut or pierced by sharp object	74	0.07
Overexertion	21	0.02
Other transport	3,275	3.3
Other and unspecified causes	9,724	9.9
Total Deaths	97,860	100.0

^a From Centers for Disease Control and Prevention. Recommended framework for presenting injury mortality data. MMWR 1997;46(RR-14).

^b An additional 501 water transportation–related drownings are included in Other transport.

^c An additional 4,545 pedestrian fatalities and 615 pedal cyclist fatalities are included in Motor vehicle traffic.

Produced by: Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC
 Data Source: National Center for Health Statistics, Vital Statistics System

Table 3
Leading Causes of Nonfatal Injuries Treated in Hospital Emergency Departments,
United States, 2000
All Ages, All Races, Both Sexes

Mechanism ^a	Number	Percent	Rate ^b
Total (overall)	29,549,711	100.0	10,752.6
Unintentional	27,550,181	93.2	10,025.0
Falls	7,434,032	25.2	2,705.1
Struck by or against a person or object	4,970,710	16.8	1,808.7
Transport ^c	4,954,232	16.8	1,802.7
Overexertion	3,233,993	10.9	1,176.8
Cut or pierced by sharp object	2,364,651	8.0	860.5
Bite or sting other than dog bite	1,036,796	3.5	377.3
Foreign body	735,214	2.5	267.5
Fires and burns	539,423	1.8	196.3
Dog bites	345,563	1.2	125.7
Poisonings	334,652	1.1	121.8
Other	1,600,915	5.4	582.5
Assault	1,672,117	5.7	608.5
Sexual Assault	63,984	0.2	23.3
Struck by or against a person or object	1,294,597	4.4	471.1
Cut or pierced by sharp object	122,080	0.4	44.4
Bites	52,141	0.2	19.0
Firearms	48,570	0.2	17.7
Other	90,745	0.3	33.0
Self-harm	264,108	0.9	96.1
Poisonings	170,243	0.6	61.9
Cut or pierced by sharp object	65,256	0.2	23.7
Other	28,609	0.0	10.4
Legal Intervention^d	63,304	0.2	23.0

^a From Centers for Disease Control and Prevention. National estimates of nonfatal injuries treated in hospital emergency departments—United States 2000. MMWR 2001;50(17):340–6.

^b Annual rates are expressed on a number of injuries per 100,000 of population.

^c The number, percentage, and rate of Transport injuries consist of the following subcategories combined: Motor vehicle occupant, Motorcyclist, Pedal cyclist, Pedestrian, and Other transport.

^d Injuries inflicted by law enforcement personnel in the course of official duties.

Produced by: Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC
 Data Source: National Electronic Injury Surveillance System (NEISS), U.S. Consumer Product Safety Commission

Scope of the Research Agenda for CDC's Injury Center

CDC's Injury Center works to prevent unintentional and violence-related injuries and to minimize the consequences of injuries when they do occur. Its public health approach draws on such sciences as epidemiology and other biomedical sciences, biomechanics and other engineering sciences, social sciences, and economics in seven topic areas:

- Preventing Injuries at Home and in the Community
- Preventing Injuries in Sports, Recreation, and Exercise
- Preventing Transportation Injuries
- Preventing Intimate Partner Violence, Sexual Violence, and Child Maltreatment
- Preventing Suicidal Behavior
- Preventing Youth Violence
- Acute Care, Disability, and Rehabilitation

Research about occupational injury, an important part of the injury field, is addressed by CDC's National Institute for Occupational Safety and Health (NIOSH). NIOSH and its partners established the National Occupational Research Agenda (NORA) to address occupational injuries. NORA can be viewed at <http://www.cdc.gov/niosh/nora>. However, research conducted in occupational settings that has important implications for nonoccupational injury prevention and control is also within the scope of the Injury Center research agenda.

Far beyond the borders of the U.S., injuries remain an important cause of death and disability. The Injury Center is committed to working with the research community to better understand and prevent injuries worldwide. However, because Injury Center funds for global health are limited, this research agenda focuses on domestic issues.

The Agenda-Development Process

To ensure consideration of a broad range of research, the Injury Center invited a wide array of constituents to participate in developing the research agenda. At the beginning of the agenda-setting process, Injury Center staff gathered input from key partner organizations and agencies that represented researchers, practitioners, and policy makers. Staff then drafted materials and presented them to topic-specific work groups consisting of 10 to 15 members, including relevant federal partners,

invited experts outside of the federal government, and Injury Center staff. Each work group met for two days to identify, discuss, and prioritize potential research needs.

The Injury Center posted a draft of the agenda on the Internet and announced its posting in the Federal Register, inviting public comment. Through correspondence with all current grantees, relevant federal agencies, researchers, practitioners, and professional organizations, the Injury Center solicited input from the injury prevention community. The Injury Center also offered to mail copies of the draft research agenda to groups and individuals without Internet access.

Throughout the process, the Injury Center relied on guidance from members of its Research Agenda Steering Committee, which consisted of six leaders in injury control and public health with an encompassing variety of perspectives. Additionally, members of the Secretary's Advisory Committee on Injury Prevention and Control commented on the content of the draft research agenda and provided advice about its implementation.

Research Phases

To organize the body of potential research about injury prevention and control for this agenda, the Injury Center used a model for the phases of research that extends from work by Holder and his colleagues (figure 1). Building on other health research, the approach suggests that research moves along a continuum: from basic and descriptive research to intervention development and testing to research about disseminating and maintaining effective intervention strategies. The research priorities in the chapters that follow address all of these phases.

Figure 1

Phases of Injury Research: The Injury Research Framework

Foundational

Foundational research covers the basic studies and public health surveillance approaches that define and quantify the extent of an injury problem. These activities establish the causes of injuries, create causal models for injury prevention, and provide a foundation for developing theory-based interventions.

Developmental

Developmental research supports the design and preliminary testing of potential strategies to prevent and control injuries. Included are risk-factor research and pilot and feasibility studies that measure how interventions affect key variables in the causal chain.

Efficacy and Effectiveness

Efficacy and effectiveness research assesses whether a given intervention actually reduces injuries. These studies establish whether an intervention has the desired effect, estimate the effect size under optimal and real-world conditions, measure the costs of the intervention, and identify unintended consequences. Ideally, efficacy should first be established under conditions that optimize both the intensity of implementation and the study population's acceptance of the intervention.

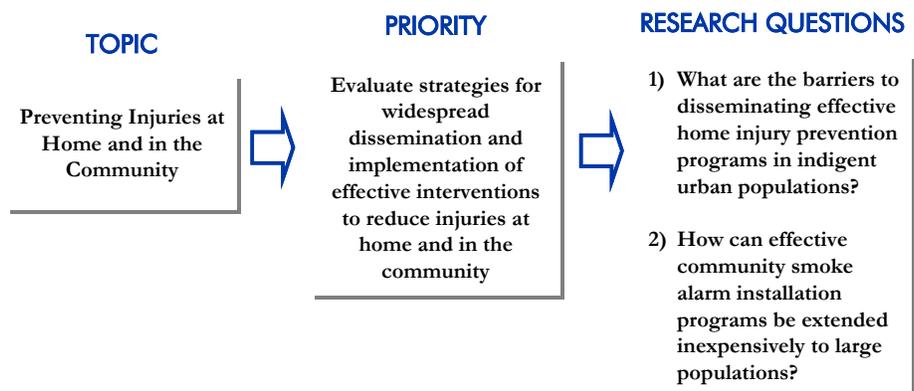
Dissemination

Dissemination research examines the robustness of intervention effectiveness given variations in implementation and/or acceptance of the intervention. Studies focus on methods to encourage practitioners and policy makers to adopt science-based programs, policies, and laws that reduce intentional and unintentional injuries and on factors that increase organizational and community capacity for tailoring, implementing, and sustaining effective interventions.

Developing Research Priorities

This agenda defines a research priority as an important injury problem that can be meaningfully addressed with a modest number of research studies (approximately 10 to 20) and that can include several related research questions. Figure 2 shows an example of a research priority for the topic Preventing Injuries at Home and in the Community.

Figure 2
Example of Topic, Priority, and Research Questions



To identify research needs for each topic, Injury Center staff reviewed the current state of knowledge in the field and noted the most critical research gaps. Then, work group members generated many priorities, revised them, and identified those the Injury Center should address in the near term. The work group process fostered debate and created a forum where ideas and suggestions could be introduced to broaden the Injury Center's perspective. This breadth is reflected in the priorities enumerated in the topic-specific chapters.

Priority Selection Criteria

Three criteria guided the selection of Injury Center research priorities: institutional mission, public health burden, and research opportunity (figure 3). Above all, the research priorities had to match the Injury Center’s mission of reducing the incidence, severity, and adverse outcomes of injury through the application of public health methods. Thus, research that applies directly to public health practice received primary emphasis. Consideration of the public health burden ensured inclusion of research about the major types and causes of injuries. An emphasis on research opportunity encouraged further focus on risk factors and interventions associated with a large, preventable fraction as well as on interventions that will soon be ready for widespread dissemination.

Three criteria guided the selection of research priorities: institutional mission, public health burden, and research opportunity.

Figure 3

Criteria for Injury Center Research Priorities

Mission (Note: Mission supercedes other criteria.)

- congruent with CDC's priorities and mission (e.g., emphasis on applying research findings and on public health methods)
- congruent with Injury Center's mission and objectives
- congruent with programmatic niche to advance specialization and avoid duplication of effort in the field
- opportunity for leadership and coordination in the field
- interest and demand from practitioners, policy makers, and the public

Public Health Burden

- absolute number of people affected
 - mortality and hospitalization
 - economic and social costs
 - disability and quality of life
 - duration of effect
- equity or social justice (i.e., addresses the needs of vulnerable populations)

Research Opportunity

- portion of the injury problem that will likely be reduced (i.e., preventable fraction)
- likelihood that the research will lead to widespread adoption of an effective intervention in a short time
- opportunity for innovation and broad application (i.e., cross-cutting knowledge)
- availability of rigorous methods for effective and ethical research
- accessible populations (e.g., managed care)
- responsiveness to emerging issues

Selection Criteria Summary

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks in each topic-specific chapter. Staff also identified research priorities that span topics. These cross-cutting research priorities are described in the section that follows.

NOTE: For all priorities in this agenda, special attention should be paid to vulnerable populations that experience disparate, elevated risks. Such groups include racial and ethnic minorities, persons with disabilities, the youngest and oldest Americans, recent immigrants, and rural residents.

Staff identified the priorities that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years.

Cross-cutting Priorities for Injury Research

This research agenda presents priorities in topic-specific chapters. However, certain issues are relevant to multiple topics. The breadth of the Injury Center's research and its place within the broader public health field offer tremendous opportunities for investigating these cross-cutting issues. Including priorities of this nature greatly enhances the applicability of the research results and increases the opportunities for independent and joint funding from multiple sponsors.

A. Evaluate the most effective methods for translating research findings into public health programs and policies.

Once researchers have demonstrated the effectiveness of an intervention in a limited setting, they must consider a number of issues before bringing the intervention to a larger population. These issues share similar characteristics across a range of intentional and unintentional injuries and even other public health problems. For example, research should investigate how to increase organizational and community capacity for tailoring, implementing, and sustaining effective interventions. Solutions might involve knowledge of sociocultural and environmental influences on behavior, organizational leadership and infrastructure, community engagement, and coalition building. Dissemination and communication research to learn how to encourage practitioners and policy makers to adopt science-based programs and enforce policies, laws, and regulations that reduce intentional and unintentional injuries will have a broad impact.

B. Evaluate the effectiveness of interventions to improve parenting skills and reduce risky use of alcohol.

Among the modifiable risk factors that affect many types of injury, parenting and risky alcohol use may be two of the most prominent. Parenting interventions are effective in reducing and preventing child maltreatment. Increasingly, evidence suggests that parenting interventions may also affect the risk of other types of violence, including intimate partner violence, youth violence, and suicide.

The effectiveness of various modes of parenting in preventing unintentional injuries is not understood as well as in the case of child maltreatment. Parenting appears to influence health behaviors such as risk taking by teen drivers. In addition, parenting programs designed to prevent child maltreatment have demonstrated a simultaneous reduction of home hazards.

Excessive alcohol intake and alcohol dependence increase the risk of a variety of injuries and medical conditions. Primary prevention strategies to reduce youth access to alcohol are particularly important because individuals who begin drinking alcohol as teens and adolescents are at greater risk for alcohol abuse and dependence in adulthood. Although researchers and practitioners have identified some effective strategies, more research is needed to better understand which factors and policies have the strongest influence on youth alcohol use.

Secondary prevention strategies for alcohol use and abuse often involve screening medical patients for alcohol problems when they present for care. Screening and brief counseling interventions have shown promising results for emergency department and trauma patients. However, before these clinical preventive services can be broadly disseminated, further research is needed to demonstrate effectiveness in multiple settings, refine procedures, and increase efficiency. Legislative and community-based behavioral interventions that address alcohol and effectively reduce transportation injuries may also reduce violence, falls, and drowning or require minor modifications to do so. The entire field of public health, including injury prevention, can benefit from a better understanding of the barriers and solutions to wider adoption of alcohol interventions that reduce injuries.

C. Identify the costs and consequences of injury.

Information about the costs and consequences of injury is crucial so that employers, government leaders, and the public can accurately gauge the impact of injury relative to other issues they face. Long-term physical, psychological, and economic consequences of injuries for all affected groups—injured persons, their families and employers, and society—require better delineation. Epidemiologic and economic research can augment

Information about the costs and consequences of injury is crucial so that employers, government leaders, and the public can accurately gauge the impact of injury relative to other issues they face.

the information currently available and can be used to prioritize prevention and control activities. Standardizing methods to estimate costs is essential to facilitate useful cost-effectiveness research and to stimulate investments in injury prevention and control by both public and private sectors.

D. Build the research infrastructure.

Reducing the burden of injury requires ongoing investment in the injury research infrastructure. An entire field of injury control research has evolved over the last two decades. For injury research to move to the next level of maturity, an integrated network of researchers, mentors, and students must exist. Individual research grants alone are insufficient to continue this progress. There is a need to introduce students to injury research both in the classroom and through hands-on experience, to improve linkages between classroom and community learning, and to cultivate opportunities for new and experienced researchers as well as community practitioners to exchange ideas and develop a greater appreciation of the depth and breadth of the field of injury research. Many activities can serve these goals: training programs; programs linking researchers with practitioners; conferences; effective use of information technology, including data clearinghouses; injury research centers; and interdisciplinary collaborations. The injury research field can also benefit from integration with the public health research community that addresses issues other than injury. Such integration can include training, participating in longitudinal studies or other large-scale research projects, and developing research methods that extend beyond injury.

Preventing Injuries at Home and in the Community

Public Health Burden

In 1998 in the United States, more than 10 million people were injured at home severely enough to warrant an emergency department (ED) visit. This constituted 29% of all injury-related ED visits and 11% of all ED visits overall. Many factors and events contribute to injuries in the home and community. For the purposes of the Injury Center's research agenda, home and community safety research includes fires, falls, dog bites, poisonings, consumer product-related injuries, choking (including strangulation and suffocation), and scalds and other nonfire burns. Other injuries such as playground, pedestrian, and bicycling injuries are included in the agenda's chapters about sports, recreation, and exercise and transportation.

Two major sources of injuries at home and in the community are fires and falls.

Two major sources of injuries at home and in the community are fires and falls. In 1999, fires were the third leading cause of injury-related deaths among children 1 to 9 years old and the fifth leading cause among people 65 and older. Falls were the third leading cause of injury-related deaths among Americans of all ages and were the leading cause of injury-related deaths among people ages 65 and older. Of older adults who fall, 20% to 30% suffer moderate to severe injuries that reduce mobility and independence and increase the risk of premature death. The total direct cost of fall injuries for people 65 and older in 1994 was \$20.2 billion. Falls are the leading cause of ED visits among children, accounting for an estimated 3 million visits annually. Infants and children who fall from low heights are at substantial risk for head injuries, while those falling from heights of 10 feet or more may also sustain other, multiple, serious injuries.

The Injury Center's Niche in Home and Community Injury Prevention

Injuries occurring in the home and in the community represent a significant public health burden in health care costs, injuries, and deaths. CDC's Injury Center can lessen this burden by developing, evaluating, and promoting effective interventions in the home and in the community. Public perception that injuries are "accidents" that cannot be prevented hinders prevention efforts. Using the public health approach to injuries,

CDC's Injury Center conducts surveillance and research and translates science into effective public health practice.

Residential and community injuries derive from many sources and involve many products, environments, and risk groups. Addressing this complexity requires varied approaches and multiple partners. One of the Injury Center's key partners is the U.S. Consumer Product Safety Commission (CPSC), which conducts research to protect the public from unreasonable risks of injury or death caused by consumer products. CPSC and the Injury Center jointly conduct nationally representative ED surveillance of injured persons.

The National Institute for Child Health and Human Development (NICHD) conducts research about home and community safety, including pilot work about child supervision. The Injury Center intends to conduct applied research about supervision using results from NICHD foundational research. The Maternal and Child Health Bureau (MCHB) of the Health Resources and Services Administration provides training and technical assistance in injury prevention. The Injury Center complements MCHB work in state health departments by funding prevention programs in states with active MCHB programs.

Several nonprofit organizations conduct programs to promote safety in the home and community, particularly the National SAFE KIDS Campaign, the National Fire Protection Association, and the National Safety Council. The Injury Center has collaborated with these as well as other federal and nonprofit partners to build more effective interventions at the community level. Examples include research about smoke alarm technology; analysis of residential fires, including their causes and risk factors; prevention of older adult falls; and promotion of effective childhood injury prevention strategies. The U.S. Fire Administration (USFA) has authority in fire suppression and responsibility for primary data collection on causes and consequences of fires. The Injury Center works with USFA to support improved fire and burn surveillance. Other federal agencies also address older adult falls, including the Centers for Medicare and Medicaid Services (quality-of-care and cost/benefit issues), the National Institute on Aging (biology of aging, older adult fall prevention trials), and the Administration on Aging (programs). The Injury Center pursues many opportunities for collaboration with these agencies to support science and public health practice promoting home and community safety.

Residential and community injuries derive from many sources and involve many products, environments, and risk groups. Addressing this complexity requires varied approaches and multiple partners.

The Injury Center's Research Priorities in Home and Community Injury Prevention

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the five most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks.

Priorities

A.* Evaluate strategies for widespread dissemination and implementation of effective interventions to reduce injuries at home and in the community.

Research has demonstrated that many interventions at home and in the community work: smoke alarms and sprinklers, bicycle helmets, stair gates and window bars, secured storage for poisons, child-proof cigarette lighters, and others. However, many of these strategies have not gained wide acceptance in some areas and among particular racial, ethnic, and socioeconomic groups for economic and other reasons. Encouraging widespread adoption of these efficacious interventions calls for dissemination research.

Research should focus on effective home- and community-based interventions, especially large-scale community injury prevention programs and policies. Demonstration programs should be developed and evaluated to determine the effectiveness of various persuasive communications techniques, audience segmentation, various dissemination strategies and communication channels, tailored messaging, and collaboration models to speed diffusion and widen adoption. Research that builds on the strengths of a community and encourages the community to participate in the research process and develop the capacity to sustain the benefits of interventions will be of additional value.

Research has demonstrated that many interventions at home and in the community work. However, many of these strategies have not gained wide acceptance.

B.* Identify modifiable behavioral responses to residential fires and evaluate interventions to prevent fire-related injuries in mass trauma events.

Almost three-quarters of all fire and burn deaths occur in the home. Residential fires killed nearly 2,900 people and injured 16,000 in 1999. Researchers have identified the major causes of most fires: cooking, heating equipment, and smoking. They have also identified the groups at highest risk of injuries from fires: very young children, older adults, people with disabilities, and people who live in poverty. Additionally, research has shown that residential smoke alarms, *when functional*, can prevent 50% to 80% of deaths by providing early warning of fires, which often occur at night when people are sleeping.

Research should identify behavioral responses—what people do—when a residential fire breaks out. Researchers need a better understanding of the social, environmental, and behavioral circumstances that affect an individual’s ability to escape safely once a fire starts. These circumstances include the development, practice, use, and effectiveness of fire escape plans and other aspects of evacuation; the presence and use of appropriate fire extinguishers; the existence of functioning smoke alarms in appropriate areas of the home; and fear of and maladaptive responses to uncontrolled fire and smoke. Further, research is needed to identify strategies that improve the abilities of high-risk persons to detect and escape from a fire, including older adults, who may not hear commercially available smoke alarms; young children, who may not know how to respond effectively; and people with physical and mental disabilities. Rural residents are 1.5 to 3.5 times more likely to die in a fire than urban dwellers. Interventions to reduce this disparity are needed.

Research is also needed to address evacuation strategies in mass trauma events, such as large office and school building fires. Such findings can also be applied to events related to bioterrorism, terrorist attacks, bombings, and building collapses. Although the 2001 World Trade Center fire was the most dramatic, recent example of fire-related mass trauma, fires killed more than 100 people in commercial buildings in 1999. Strategies such as fire

safety policies, disaster planning, education programs, and other methods of preventing and escaping fires in emergencies should be evaluated. Examples of this type of research include evaluating the effectiveness of environmental modifications that facilitate egress, such as architectural design, exit signs, construction specifications, and building codes; improving residential and building safety inspections; and adding or modifying home and commercial sprinklers and other fire extinguishing systems, floor and stair designs, electrical systems, and hard-wired smoke alarms. To integrate human factor issues into performance-based fire safety designs and regulations, researchers will need a better understanding of human reaction to fire and of fire risk perception. Such research will necessitate a broad, interdisciplinary approach involving many professionals in fire prevention, safety science, engineering, psychology, design, and environmental and policy science.

C.* Develop and evaluate community-based interventions to prevent falls among older, community-dwelling adults and study the dissemination of those programs.

Approximately 30% of older adults and 40% of those over age 80 report having fallen in the past year. Falls account for 29% of injury deaths among adults ages 65 and older and result in 300,000 hip fractures annually at a cost of more than \$10 billion. Individual factors known to increase the risk of a fall include low muscle tone and balance problems, vision problems, polydrug and psychotropic medication use, and sedentary lifestyles. Less conclusively, research suggests that some home hazards and lifestyle behaviors may also contribute to the risk of falling.

Research about fall prevention is needed for three phases: dissemination, efficacy and effectiveness, and developmental.

Research about fall prevention is needed for three phases: dissemination, efficacy and effectiveness, and developmental. For proven interventions such as strength and balance training and medication review and adjustment (especially for psychotropic drugs), research is needed to identify barriers to widespread adoption by public health and health care professionals. Researchers have already identified some barriers. For example, some health professionals do not have adequate information about effective interventions; others may have the information

but do not use it in their work with patients and the public. Once researchers have identified the barriers to widespread adoption, they should develop and test strategies for overcoming them.

Research is needed to develop and evaluate approaches to implementing and disseminating effective fall prevention programs in the community, especially programs involving multiple strategies. This includes research to identify the best formats and channels for delivering interventions to ensure that older adults adopt them. Health services and operations research is necessary to develop model infrastructures for service delivery that include partnerships between public health agencies and networks that serve the aging community. Research is also needed to identify people most in need of falls prevention programs and to discern whether different programs work for different subgroups (e.g., frail older adults, people who have fallen previously, and people with a fear of falling).

Finally, for some interventions, researchers and practitioners have little information about the intervention's effectiveness when it is broadly applied in the community. Examples include vision enhancement (e.g., vision screening and correction, home lighting improvements) and hip pads. Research should evaluate these interventions and determine how best to implement them in community settings with older adults. Further, researchers should use the results of biomechanic and other research to design and test new interventions.

D.* Among young children, determine the immediate causes of the most severe and disabling types of falls and develop and evaluate interventions to prevent them.

Of the nearly 3 million ED visits each year for falls among children and adolescents, more than 40% occur among infants, toddlers, and preschoolers. Annual direct medical costs for falls among young children are estimated at \$958 million. Two key determinants of fall-related injuries are characteristics of children at greatest risk and the causal sequence of events leading to the fall. Falls that result in a traumatic brain injury are of particular concern. In the home, such an injury may occur after a fall from

a great height (e.g., down a staircase) or from a lesser height (e.g., off a changing table). Research should develop and evaluate interventions in home and community settings to reduce the major risks and most serious consequences of falls among children.

E.* Develop methods to better define and measure aspects of supervision for children and impaired older adults.

Supervision is generally considered one of the strongest yet least understood protective factors against many types of home and community injuries, including playground injuries, drowning deaths, dog bites, and child pedestrian injuries. The developmental ability, temperament, and cognitive and physical abilities of children affect their requirements for supervision and the effectiveness of supervision. These factors also influence the degree of supervision needed for impaired older adults, such as those with Alzheimer’s disease, Parkinson’s disease, or stroke, and for children with special needs.

Research should develop and validate a classification scheme for supervision to capture the variety of supervisory patterns currently used across a spectrum of ages and cultures. Researchers should develop measurement tools to describe and compare various styles of supervision and their relative effectiveness in preventing injuries.

F. Determine the impact of legislation, litigation, and regulation in preventing specific home and community injuries.

Legislation, litigation, and regulation have been used to prevent injuries, but their relative effectiveness has not been established. Legislation addresses motor vehicle traffic and the design, manufacture, sale, possession, or use of a product. Litigation is used to uphold the law. Regulation addresses specific issues, such as building codes or ordinances banning specific dog breeds. Researchers should evaluate each of these approaches to injury prevention.

Supervision is generally considered one of the strongest yet least understood protective factors against many types of home and community injuries.

G. Develop and evaluate interventions to prevent dog bite injuries.

Dog bites accounted for an estimated 4.7 million injuries in 1994; of the nearly 800,000 people who sought medical care for dog bites, approximately half were children. Modifiable risk factors for dog bites include victim behaviors, characteristics of the dog, and behaviors of the dog owner. Modifiable community factors include dog leash laws, neutering norms, and the prevalence of dog ownership training and school-based and educational programs delivered by veterinarians and medical care personnel. Researchers should develop and evaluate programs to modify risk factors to prevent dog bites and related injuries.

H. Develop and evaluate programs to prevent scalds and nonfire burns.

Scalds, contact burns, and electrical and chemical burns are frequent causes of nonfatal, nonfire injuries. Scalds from hot liquids are the most frequent cause of these injuries; 95% of scalds occur among children younger than 5 years old. Research is needed to identify or develop, then evaluate, practical and effective solutions to reduce scalds and nonfire burns. Important factors to investigate include the role of supervision and water tap temperature regulators.

I. Study the relationship between the urban environment and the occurrence of unintentional and violence-related injuries.

Community changes in land use, housing development, and personal transportation may increase or decrease residents' exposure to harm. For example, changes in exposure can occur by shifting transportation from car to bicycle or foot; by increasing the amount of recreational time spent outdoors near traffic; by isolating homes and schools from traffic; or by other structural changes. These aspects of the community environment and their construction, maintenance, and alteration may have consequences for unintentional injury or interpersonal violence.

Structural changes are rarely studied in a comprehensive manner. Researchers should investigate the relationship between characteristics of the built environment and the occurrence of unintentional and violence-related injuries and assess how changing these characteristics affects these types of injury.

Preventing Injuries in Sports, Recreation, and Exercise

Public Health Burden

Participation in sports, recreation, and exercise (SRE) is increasingly popular and widespread in American culture. SRE activities include organized sports (school or club) and unorganized sports (backyard or pick-up), such as basketball, football, and hockey; recreational activities, such as boating, biking, skiing, swimming, and playground activities; and exercise and training activities, such as weight-lifting, aerobics, and jogging.

At least one of every five ED visits for an injury results from participation in sports or recreation.

Participation in SRE activities contributes to health-related fitness; however, the risk of injury is inherent in any physical activity. Drowning is the second leading cause of injury death among children ages 1 to 14 and kills more than 4,000 Americans annually. More than 10,000 people receive treatment in the nation's emergency departments (ED) each day for injuries sustained in SRE activities. At least one of every five ED visits for an injury results from participation in sports or recreation. In 1999, Americans made an estimated 1.5 million ED visits for injuries sustained while playing basketball, baseball, softball, football, or soccer. Approximately 715,000 sports and recreation injuries occur each year in school settings alone. Injuries are also a leading reason people stop participating in potentially beneficial physical activity.

Risk of injury varies by many factors, including specific activity and participant age. Children younger than 15 account for 25% of all drownings and about 40% of all SRE-related ED visits. They may be at risk because of immature or undeveloped coordination, skills, and perception. Adolescents and young adults under age 25 have high participation rates in SRE activities and experience almost one third of all SRE-related injuries. The population of older adults is increasing, and little is known about their injury risk during participation in SRE. In 1996, EDs treated more than 53,000 SRE-related injuries among people 65 and older, a 54% increase from 1990.

Few data exist about injury incidence and prevalence, costs, relative risks of injury from different activities, risk and protective factors, and effective programs to prevent SRE injuries. While some ED surveillance data are available, they lack exposure information and exclude the large

proportion of SRE injuries that are treated in primary care settings, sports medicine clinics, orthopedic clinics, and chiropractic clinics.

The Injury Center's Niche in Sports, Recreation, and Exercise Safety

CDC's mission includes both promoting physical activity and preventing injuries. While another center at CDC has an active research program in physical activity, the Injury Center includes a focus on sports, recreation, and exercise injury prevention. Although the scope and depth of this research has been limited, the Injury Center is uniquely positioned to provide epidemiologic and prevention research about SRE-related injuries. Few other federal agencies or national organizations consistently fund broad-based research into SRE injuries. Examples of federal agencies with interest in SRE include the National Institutes of Health (NIH), the U.S. Coast Guard, and the U.S. Consumer Product Safety Commission (CPSC). NIH supports some foundational research in SRE-related trauma and injury prevention and the Coast Guard supports boating safety programs and some surveillance. CPSC provides excellent ED surveillance; however, its information does not include data about participation rates (exposure data) that could facilitate comparisons. CPSC traditionally focused on product-based research to protect consumers from hazardous products; with Injury Center funding, CPSC recently expanded its ED surveillance to include all injuries treated in the ED, regardless of cause.

Working with other agencies, nonprofit organizations, and professional organizations, the Injury Center can provide complementary research to facilitate safe sporting environments and identify risk and protective behaviors. The Injury Center has convened two working groups related to surveillance and research methodologies in SRE, and it continues to play a coordinating role in the field. Through its connections with organizations such as the National Collegiate Athletic Association, National Athletic Trainers' Association, and the American Academy of Orthopaedic Surgeons, the Injury Center can foster collaborations to leverage maximum benefit from scarce funding for SRE injury prevention research. Other important and appropriate activities include developing new surveillance methods to capture exposure data; providing linkages to medical care, emergency department, and other public health-oriented data bases; and developing and effectively disseminating science-based interventions.

The Injury Center is uniquely positioned to provide epidemiologic and prevention research about sports-, recreation-, and exercise-related injuries.

The Injury Center's Research Priorities in Sports, Recreation, and Exercise Safety

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the four most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks.

Priorities

A.* Evaluate strategies to increase dissemination and use of effective interventions to prevent SRE injuries.

Effective interventions exist to prevent SRE injuries, but they frequently are not used. Examples include bike helmets and other protective equipment, break-away bases, impact-reducing playground surfacing, and isolation pool fencing. Research should assess factors that hinder and encourage individuals' and organizations' adoption of these effective interventions, including sociocultural and environmental influences, organizational leadership and infrastructure, community engagement, and coalition building. Studies should also assess different methods to increase awareness of effective interventions, tailor programs to local circumstances, and maintain fidelity to intervention guidelines. CDC's strength in program implementation, evaluation, and health communication makes research in this area a natural opportunity, and advances will be broadly applicable to other health promotion areas. Research would benefit current interventions and programs in drowning prevention, playground safety, bicycle safety, and any SRE activity with efficacious interventions.

B.* Evaluate environmental, behavioral, and legislative or regulatory interventions to prevent SRE injuries.

Many promising interventions exist but have not been evaluated. These include modifications of physical play environments, use of current and newly designed safety gear, and gender- and age-specific equipment requirements. The importance of the presence

Effective interventions exist to prevent SRE injuries, but they frequently are not used.

and training of coaches and certified athletic trainers should be examined, as should be the roles of parents and physicians in preventing injury in organized sports. Finally, research is needed to assess the effects of policies and practices about the use of safety gear, practice guidelines and rules of play, and informed officiating. Tools to evaluate interventions in these areas may include impact biomechanics and epidemiologic research.

C.* Evaluate existing and develop new methods to obtain exposure and injury incidence data for SRE.

Recent reports estimate that approximately 3.7 million ED visits occur each year for injuries related to participation in sports and recreation. However, without reliable methods for estimating frequency and duration of participation in these physical activities (i.e., exposure data to calculate denominators), researchers cannot determine injury rates and compare them across activities. Population-based SRE injury information may be obtainable from a variety of sources. Several population-based participation surveys exist and, if validated, may serve as sources of denominator data for such studies. Accurate estimates of numbers of injuries combined with injury rates will enable researchers to examine risk and protective factors and explore prevention strategies. These findings will facilitate more effective, programmatic decision making.

D.* Determine the short-term economic costs of injuries related to SRE.

SRE injuries are not a major source of mortality, but they do place a large burden on the health care system for both initial care and rehabilitation. They also result in costs related to lost productivity and other factors. Despite the large number of ED visits for these injuries, most medically treated SRE-related injuries are treated by health care providers outside of the emergency setting, indicating that the magnitude of the problem is much greater than ED statistics suggest.

The cost of anterior cruciate ligament reconstruction alone, not including initial evaluation or rehabilitation, is just under \$1 billion per year in the U.S.

For example, in the U.S., anterior cruciate ligament (ACL) knee injuries are usually sports related, and the vast majority occur in active, healthy 15- to 24-year-olds. ACL rupture can be debilitating in the short term, preventing continued physical activity. The cost of ACL reconstruction alone, not including initial evaluation or rehabilitation, is just under \$1 billion per year in the U.S. Data from other countries also suggest that the cost of other SRE-related injuries is quite high. Quantifying health care and other economic costs to society of SRE-related injuries and delineating the sources of those costs will provide an important foundation for documenting the public health burden of these injuries.

E. Identify risk and protective factors and evaluate interventions for injuries related to open-water recreation.

Submersion injuries and drownings in lakes, canals, rivers, and oceans are a growing problem, accounting for one quarter to one third of all drownings (or 1,200 drownings in 1998). While open-water drowning fatalities represent only about 12% of drownings among children ages 14 and younger, they account for more than 30% of drownings among adolescents over age 14 and among adults. Ninety-one percent of open-water drowning victims are men. Much of the problem can be attributed to unsafe boating. In fact, in 1999, 734 people died and another 4,300 required medical care as a result of boating activities.

To design effective interventions, it is necessary to identify modifiable risk factors. Research is needed to assess the role of cultural factors responsible for ethnic and gender disparities in drowning rates; the role of alcohol in drownings and in boating-related injuries and deaths; the importance of swimming ability, supervision, and lifeguarding services; and the contribution of drowning prevention skills in preventing open-water submersions in various environments.

Although many safe boating programs, policies, and recommendations are in effect, few have been rigorously evaluated. Research about the components of safe boating should investigate the efficacy and effectiveness of boating safety education courses, personal flotation devices (PFD), and various

laws and policies aimed at improving boating safety. To further reduce the number of boating-related injuries, the effectiveness of these and other interventions as they relate to size and type of boat, water environment type, and operator characteristics must be improved. CDC can supplement the Coast Guard's injury surveillance and educational efforts by evaluating promising interventions and programs.

F. Evaluate residential pool safety measures for children.

About 4,000 Americans drown each year; approximately 1,000 are children under age 15. A majority of child drownings occur in residential, backyard pools. While some drowning prevention interventions have been evaluated, further delineation and evaluation of their risks and benefits is necessary. Interventions to be evaluated may include those that address either physical/environmental factors such as pool alarms, pool covers, and door alarms or behavioral factors such as PFD use, CPR training, supervision, and swimming lessons.

G. Identify ways to minimize injury risk among people initiating or increasing physical activity.

Many factors influence recommendations for starting and increasing physical activity, including age, gender, fitness level, nutritional status, anthropometry, and injury history. Research should identify strategies to improve physical fitness of participants at all fitness levels while minimizing the risk of injury. Knowledge about differences in human tolerance by age, fitness level, and gender is an important prerequisite for prevention, as is knowledge about the biomechanics and injury tolerances of tissue, bone, and other human structures. Ideally, researchers should develop science-based guidelines for choosing an activity and recommend the frequency, intensity, and duration of participation given a prospective participant's current fitness level and past injuries. Research should also evaluate personal protective devices and training programs. Special populations, including children, older adults, women, and people who are obese or undernourished, should receive particular attention.

Research should identify strategies to improve physical fitness of participants at all fitness levels while minimizing the risk of injury.

H. Identify risk and protective factors for and evaluate interventions to prevent injuries from outdoor recreation.

Little is known about the risk factors for, and prevention of, injuries in common outdoor recreational activities, such as riding personal watercraft, snowmobiles, and all-terrain vehicles; hiking and climbing; skiing; and participating in equestrian activities. Approximately 73,000 ED visits annually are related to participation in equestrian activities alone, and many thousands of people are injured each year while using personal recreational vehicles. Other injuries from outdoor recreation result from recreational fires, avalanches, and insect, snake, and other animal bites. Studies should address education, protective equipment, vehicle design, the role of alcohol, and posted warnings as well as promising public policy and legislative interventions.

I. Evaluate the effectiveness of interventions to improve bicycling safety.

Approximately 81 million people ride bicycles, and each year, more than 600,000 visit the ED for bicycle-related injuries. Many of these injuries occur in traffic. Research should examine the traffic interaction of bicycles and motor vehicles to identify ways to improve road sharing and increase safety for bicyclists. It should evaluate safety training, bike skills classes, and bike maintenance as components of bicycle safety programs. Additionally, biomechanics research can contribute to improved bike and helmet design.

J. Evaluate how injuries are affected by changing the physical environment to increase physical activity while promoting and preserving safety.

A 1994 survey reported that 20% of adults (38 million) rode bicycles outdoors and 73% (138 million) walked for exercise in the 30 days before the survey. During this time period, 1% to 1.5% reported that they had been injured while doing these activities. As efforts increase to promote walking and bicycling for improved health and for transportation, the potential for injury

may also increase. Research is needed to assess the health and safety effects of environmental changes designed to increase physical activity in a community, such as community exercise facilities, sidewalks and bike trails, bike lanes, pedestrian malls, sports parks, and skate parks. It is important to study the effects of these dedicated spaces on injury rates, use rates, and exercising behavior to help identify and promote safe environments for physical activity.

K. Quantify the injury risks of physical activity among older Americans.

In 1996, people ages 65 and older made 53,000 sports-related ED visits. This represented an increase of 54% since 1990, while the population grew by only 8% in the same time period. As Americans live longer, they will likely remain active longer, increasing the need for effective injury prevention strategies for active older adults. Additionally, research suggests that exercise is important for older Americans to maintain physical and mental health and independence. Research in this area should focus on understanding the risks of various SRE activities in this population and, where possible, examine risk in the context of research about the benefits of these activities.

L. Determine the effect of playground design on injury patterns.

Approximately 200,000 children each year visit EDs for playground-related injuries. Injury prevention efforts should focus on identifying environmental and supervisory modifications. Research should begin by studying the components of the problem: developmental and other characteristics of children, physical aspects of indoor and outdoor equipment and play spaces, and the balance between safety and the level of challenge the equipment poses. Effective prevention strategies will address each component, as well as the relationships among them. Research may also help define the role of supervision in various settings.

About 60% to 80% of playground-related injuries involve falls. Research should include testing of indoor and outdoor playground surfaces to determine which ones protect children from injury and which ones increase the likelihood of injury. Researchers should study children's behavior, human tolerances or impact biomechanics, and ideal surface characteristics.

Research should also address how best to combine injury prevention and requirements of the Americans with Disabilities Act (ADA). ADA requirements are intended to ensure that children with disabilities have equal access to appropriate play spaces. However, common playground surfaces that lessen injury-producing forces may hamper the mobility of children with disabilities, and pathways that allow easy access are frequently tripping hazards. Research should identify materials and mechanisms that will accomplish both safety and accessibility needs.



Preventing Transportation Injuries

Public Health Burden

Transportation-related injuries occur from travel on the ground, in the air, and on water. The overwhelming majority of these deaths and injuries result from motor vehicle ground transportation. In 1999, motor vehicle traffic crashes resulted in 40,965 deaths and were the leading cause of death in the United States among people ages 1 to 34. Each year, an additional 3.5 million people suffer nonfatal motor vehicle-related injuries, causing about 4 million emergency department visits and 500,000 hospitalizations. The economic impact is substantial. In 1994, motor vehicle crashes cost more than \$150 billion in property damage, lost productivity, and medical expenses. These estimates do not include the unquantifiable costs of pain and suffering or the value of lives lost.

Despite achievements such as increased safety belt use and declining numbers of crashes involving alcohol, injuries and fatalities caused by motor vehicle crashes remain a serious public health problem. Data reveal the need to direct prevention efforts to specific groups, such as older adults, teens, and children. Pedestrian fatalities are a growing problem, and alcohol persists as a factor in many crashes and injuries. Collaboration among many partners is essential to prevent a wide array of transportation-related injuries.

CDC has been instrumental in framing motor vehicle injury as a public health problem and in helping to raise public awareness that these injuries are predictable and preventable.

The Injury Center's Niche in Transportation Safety

CDC's Injury Center conducts and sponsors population-based epidemiologic, public health, behavioral, biomechanic, and trauma research to develop practical, community-based prevention strategies for motor vehicle-related injuries. CDC has been instrumental in framing motor vehicle injury as a public health problem and in helping to raise public awareness that these injuries are predictable and preventable.

The Injury Center's research programs focus on determining the magnitude, severity, and cost of motor vehicle injuries; the size and vulnerability of populations at risk; the influence of co-existing medical conditions on crashes and injuries; and causes, risk factors, and effective

interventions applicable to public health settings. It is unique in its use of hospitals and emergency departments to collect motor vehicle injury data and to conduct brief interventions. The Injury Center's peer-review process to select and fund research also distinguishes its work and advances the field; grantees publish their findings in peer-reviewed literature, accelerating the accessibility of knowledge for scientists and public health practitioners. Seven of the 11 CDC-funded university Injury Control Research Centers conduct research about transportation-related injury issues.

The Injury Center's research priorities in transportation safety build on CDC's expertise. The focus on alcohol as a risk factor draws on long-standing efforts to document the effects of alcohol on health and safety. Ongoing research includes behavioral risk factor surveillance of alcohol and driving and the identification of risk and protective factors. An emphasis on older drivers reflects CDC's focus on "healthy aging." Similarly, the Injury Center's focus on teen drivers takes advantage of CDC's expertise in quantifying and understanding adolescent health risks. For example, CDC's Youth Risk Behavior Survey tracks motor vehicle injury risk behaviors among teenagers. The Injury Center takes a developmental-risk perspective on teen drivers, which is characterized by its cooperative research with the National Institutes of Health (NIH) to study the effects of persuasive communication and parental behavior on teen driving behavior. The Injury Center also focuses attention on high-risk, hard-to-reach populations with projects such as *Niños Atrás* (Kids in the Back), which encourages adults to place children in the back seats of motor vehicles, the safest place for children to ride. And it emphasizes evaluation of community-based interventions. Its research in this area provided the science base for *The Guide to Community Preventive Services* (produced by the Task Force for Community Preventive Services), which recommends strategies to reduce alcohol-impaired driving and to increase use of safety belts and child safety seats.

The Injury Center works closely with other federal agencies, nonprofit organizations, and researchers. For example, it has a strong partnership with the National Highway Traffic Safety Administration (NHTSA), the lead regulatory agency for motor vehicle safety. The Injury Center's efforts complement those of NHTSA, which sponsors and conducts research and produces technical reports aimed at supporting traffic safety

regulations, motor vehicle safety standards, and legislative initiatives. With NHTSA, the Injury Center hosted the first international conference about preventing childhood pedestrian injuries and widely disseminated national strategies for child pedestrian safety to transportation and public health researchers and policy makers. In partnership with the World Health Organization, the Injury Center developed surveillance guidelines and recommended strategies for motor vehicle injury prevention in developing countries. Injury Center staff also participate on Transportation Research Board committees on transportation for an aging society, alcohol-impaired driving, pedestrian safety, and school bus safety. Other key partners in transportation safety include NIH's National Institute for Child Health and Human Development, the National Transportation Safety Board, the Insurance Institute for Highway Safety, the AAA Foundation for Traffic Safety, the National SAFE KIDS Campaign, and the National Safety Council.

State and local health departments are a natural constituency for the Injury Center's research, and they provide important entries to develop and implement effective interventions in communities. CDC's long history and close relationships with all 50 state health departments, local health jurisdictions, and schools of public health provide a foundation from which the Injury Center can support effective collaborations to prevent transportation-related injuries.

The Injury Center's Research Priorities in Transportation Safety

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the six most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks.

Priorities

A.* Evaluate strategies to implement and disseminate known, effective interventions to reduce alcohol-impaired driving and test the effectiveness of new, innovative strategies.

Driving after drinking alcohol is a major risk factor for motor vehicle crashes and is associated with approximately 15,000 deaths and 300,000 injuries annually. In 2000, alcohol-related fatality rates increased for the first time in several years, accounting for almost 40% of motor vehicle deaths. For motorcyclists, the rate of alcohol involvement in fatal crashes is even higher. Children are frequent victims of alcohol-impaired drivers. Annually, about 600 children under age 15 die in motor vehicle crashes while riding with drivers who are impaired by alcohol. In addition to the human costs, crashes involving alcohol are expensive. In 1997, these crashes cost Americans \$29 billion in direct costs and lost earnings. Law enforcement sources report about 1.4 million arrests for drinking under the influence (DUI) every year, but there are more than 126 million self-reported episodes of DUI.

Since 1970, states and communities have implemented an array of strategies to reduce alcohol-impaired driving. Laws and enforcement strategies to deter alcohol-impaired driving and to control the sale or public consumption of alcohol are among the most widely used strategies. Community-based interventions including sobriety checkpoints, lower legal limits for blood-alcohol content, zero tolerance laws, enhanced enforcement of alcohol control policies, and training programs for servers of alcoholic beverages have been demonstrated effective. However, a better understanding of the factors that most influence successful implementation of these prevention strategies and policies is needed. Research should include strategies drawn from health communication, policy development, advocacy, and other approaches relevant to improving dissemination and adoption of effective interventions.

In 2000, alcohol-related fatality rates increased for the first time in several years, accounting for almost 40% of motor vehicle deaths.

Research should assess existing interventions directed to high-risk groups and implemented in special settings; screening and early intervention for alcohol-impaired driving in public settings; licensing requirements; and the benefits, costs, and social acceptability of successively lower blood-alcohol concentration standards. Simultaneously, the search for new and innovative strategies for reducing alcohol-impaired driving should continue.

B.* Develop methodologies for and evaluate the effectiveness of various means to translate transportation safety research findings into public policy.

Laws have been applied at both state and federal levels to prevent motor vehicle injuries. However, few tools exist to measure how research translates into laws and regulations to encourage people to adopt safety behaviors. Research about the evolution of prevention strategies—from scientific evidence to legislation to product design and manufacturing changes—has the potential to reduce injury rates on a large scale. For example, research might evaluate the role of tort litigation in providing incentives for industry to make safer products, whether through design modifications or changes in product use. Successful examples include restraint systems, such as safety belts, child safety seats, and vehicle air bags. Research might also evaluate the types of information used to support successful policies and regulatory decisions. For instance, to determine the components of successful campaigns, evaluations could consider the persuasiveness of data about injury’s incidence, prevalence, and outcomes (e.g., disabilities and functional impairments) or the persuasiveness of cost and cost-effectiveness data.

Research should focus on the use of scientific information in formulating public policy that promotes sustainable social changes, on the costs and benefits of changes, and on improvements in public safety. The research should identify best practices for providing useful information to policy makers. Improved social marketing techniques are essential to educate opinion leaders and the public about the causes of motor vehicle–related injuries and about effective personal safety practices.

Research should focus on the use of scientific information in formulating public policy that promotes sustainable social changes, on the costs and benefits of changes, and on improvements in public safety.

C.* Evaluate the effectiveness of behavioral and environmental strategies to prevent pedestrian injury.

Pedestrians account for about 14% of motor vehicle–related deaths in the U.S. Most pedestrians injured or killed are young children, older adults, or alcohol-impaired individuals. Annually, more than 5,000 pedestrians are killed and another 77,000 are injured in motor vehicle incidents. Pedestrian injuries that occur in rural areas are more likely to be fatal than those occurring in urban areas.

Because the problem is so complex—involving pedestrian and driver behaviors, road characteristics, travel patterns, vehicle speed, and environmental variables—no single intervention is likely to sufficiently reduce the number of pedestrian injuries. For example, infants are usually injured in strollers, toddlers are often injured in driveway backovers, and preschoolers and young elementary school-age children are often injured when they dart out between cars parked on residential streets, particularly during play. Adult pedestrian injuries often involve alcohol.

Multidisciplinary approaches involving theory-based education and training programs, engineering solutions, and strong law enforcement may be necessary to effectively reduce pedestrian injuries. Research should include interventions that focus not only on pedestrians, but also on drivers and the driving environment, such as strengthening enforcement strategies for speed limits, yield-to-pedestrian laws, and school zones. Changes in pedestrian and driver behaviors and modifications in roadway environments, including traffic-calming measures, may provide the strongest mix of prevention strategies. Research should develop and evaluate strategies that reduce the risk of collisions, such as increased pedestrian and vehicle visibility. Research should also address the different risk factors of various groups in urban and rural settings.

D.* Identify the underlying behavioral and situational factors associated with crashes involving teens; develop and evaluate appropriate interventions to address those factors.

In 1999, 5,700 teenagers died of injuries caused by motor vehicle crashes. Research shows that teenagers are more likely than other drivers to speed, run red lights, make illegal turns, ride with an intoxicated driver, and drive after using alcohol or drugs. They are more likely than other drivers to underestimate the dangers in hazardous situations, and they have less experience coping with those situations. Young people who drive after consuming alcohol pose an inordinate risk to themselves, their passengers, and other road users.

To prevent motor vehicle crashes among teens, research should evaluate strategies that limit their access to alcohol and that promote safety belt use. Research should also identify the behavioral and developmental characteristics that predispose some teens to take higher risks than their peers. Research to identify constellations of behavioral and developmental risk factors that could be used to develop and target interventions should focus on behavioral rather than epidemiologic studies. It should examine both protective factors and risk factors, such as the roles of supervision, family, peers, risk perception, decision-making skills, and community characteristics.

Research shows that children seated in the back seat are safer than children seated in the front seat. Nevertheless, 47% of children killed in crashes are not seated in the back.

E.* Develop and evaluate interventions that address the proper and consistent use of measures to protect child occupants in motor vehicles.

In 1999 (the latest year for which fatality data are available), more than 1,100 children ages 15 and younger were killed while riding in motor vehicles. In 2000, nearly 330,000 were injured. Proper installation of age-appropriate child restraint systems, such as child safety seats or booster seats, and correct placement of children in restraints increase safety. Data show that Hispanic Americans have lower rates of child safety seat use than non-Hispanic Caucasian Americans. Research also shows that children

seated in the back seat are safer than children seated in the front seat. Nevertheless, 47% of children killed in crashes are not seated in the back.

Further research about the efficacy and effectiveness of booster seats is needed to make reliable recommendations for children who have outgrown their child safety seats. Children usually do not fit into adult seat belts until they are 4' 9" tall. Epidemiologic and biomechanic research are needed to document the efficacy of booster seats and to establish guidelines for their proper use based on variables such as age, height, weight, and other relevant anatomic dimensions.

Research might also assess the impact of child safety seat and booster seat laws as well as enforcement strategies and training/checking programs intended to increase proper use. Continued research is needed about the effectiveness of universal fasteners and alternative restraint designs, including devices that improve comfort and convenience. Research should evaluate strategies to improve proper use and decrease misuse of safety devices and to improve communication efforts to promote child occupant safety.

In addition to restraint use, research should investigate factors that influence drivers to place children in the back seat. The results of such research should guide intervention development, evaluation, and dissemination. A focus on special populations such as inner-city or non-English-speaking groups not reached by common communication channels is crucial.

F.* Among older adults, identify and measure factors that affect safe motor vehicle use.

Each year more than 7,000 persons ages 65 and older die in motor vehicle crashes, and 250,000 are injured. These numbers are likely to rise with the expected growth in this population segment. Many older adults change their transportation habits to allow for declining performance with age. For example, many stop driving at night because of vision problems. Yet little is known about how functional capacity, medical conditions, medications, and other

Little is known about how functional capacity, medical conditions, medications, and other factors affect safe motor vehicle use.

factors affect safe motor vehicle use. Several approaches are available to document these relationships, including cognitive testing, simulator studies, and applied biomechanics research. Studying the effects of vehicle design on these human interactions is another potential direction for related research. Findings from these lines of research can be used to identify older adults at greatest risk and to design public health programs to reduce the risks of crashes and injuries among that group.

G. Develop and evaluate interventions to increase the use of occupant protection devices, such as seat belts, in high-risk and hard-to-reach populations.

Certain groups of people—such as inner-city, non-English-speaking, immigrant, and rural populations and those who do not perceive the risk of driving unprotected—are at higher risk for motor vehicle–related injuries and may also be difficult to reach with traditional prevention messages or interventions. Further reductions in motor vehicle–related injury rates will require tailoring interventions, such as those to increase seat belt use, to these groups.

Research should evaluate the effectiveness of changes in vehicle and restraint design and strategies to increase adoption and maintenance of seat belt use. Developing and conducting intervention research with hard-to-reach populations presents special challenges for any public health issue, including motor vehicle safety. Knowledge gained in this field, such as innovative recruitment techniques to engage study participants and elicit valid survey responses, may be useful to other areas of public health research. Investigations should include risk factor research to support prevention programs and interventions that are targeted, tailored, and evaluated.

H. Develop and evaluate interventions to reduce motorcycle crashes and injuries.

Motorcycle safety initiatives have placed their major emphasis on wearing helmets and on helmet laws to prevent crash-related head injuries and deaths. Research should continue to evaluate the effectiveness and sustainability of these interventions. It should also identify methods for promoting the most effective interventions and for identifying the barriers to implementing and sustaining effective interventions. Research should extend beyond the focus on helmets to determine the effectiveness of other strategies to prevent not only injuries and deaths but also crashes—strategies that involve motorcycle safety training, reduction of alcohol-impaired motorcycle driving, and licensing interventions. In addition to behavioral approaches, epidemiologic and biomechanic assessments of the effectiveness of different motorcycle helmet designs may improve rider safety. (See Sports, Recreation, and Exercise section for bicycle safety research.)

I. Develop and evaluate interventions to modify hazardous behaviors such as aggressive, inattentive, and drowsy driving.

Many motor vehicle crashes reportedly result from hazardous behaviors, such as aggressive, inattentive, and drowsy driving. Research should address both individual behavior-change strategies as well as community-based strategies that could reduce the impact of these types of risky behaviors on motor vehicle safety. Attention must be given to developing methods for measuring risky behavior, assessing its impact on crash risks and outcomes, and understanding the role of risk perception.

J. Develop and evaluate interventions to prevent crashes and injuries caused by modes of transportation other than motor vehicles.

While motor vehicle crashes are the most common cause of transportation-related fatalities and injuries, other modes of transportation also pose threats to public safety. Research is needed to identify strategies that prevent collisions, crashes, injuries, and deaths from other modes of transportation, such as railroad trains (including pedestrian-train and motor vehicle–train events), aviation, public transportation, and others.

K. Evaluate the effects of emerging vehicle technologies on the risks of crashes, the risk of injuries during crashes, and crash avoidance.

Various emerging technologies may improve traffic safety. However, these same technologies may have unintended negative consequences. For example, air bags provide additional crash protection in some situations but are known to place some smaller and younger occupants at greater risk. Also, windshield information displays may allow drivers to obtain more information while driving, but these same displays may exceed information processing thresholds or may confuse older drivers who have declining cognitive processing skills. Cellular telephones make calling for emergency assistance quick and easy, but they may also distract drivers. Research should evaluate how innovations such as side air bags, new seat designs, cellular phones, laser detection devices, and telematic and other devices affect driving performance, crashes, and injuries. Cognitive, biomechanic, and other hazards of new technologies should be investigated. Researchers should give attention to the impact of vehicle and auxiliary equipment design on changes in risk and in drivers' perception of risk.

Research should evaluate how innovations such as side air bags, new seat designs, cellular phones, laser detection devices, and telematic devices affect driving performance, crashes, and injuries.

L. Identify the modifiable risk factors for and mechanisms of nonfatal neck, back, and soft tissue (“whiplash-like”) injuries.

Research should focus on the epidemiology, biomechanics, and medical outcomes of nonfatal neck, back, and soft tissue (“whiplash-like”) injury and should emphasize the research’s utility in prevention. Better knowledge of the types, severity, and mechanisms of such injuries is needed to assess accurately the public health impact and associated costs of the problem and to guide prevention strategies.

Preventing Intimate Partner Violence, Sexual Violence, and Child Maltreatment

Public Health Burden

Intimate partner violence, sexual violence, and child maltreatment have a significant effect on public health. Victims of violence can experience physical injury; adverse mental health consequences such as depression, anxiety, and low self-esteem; and harmful physical health consequences such as suicide attempts, cardiovascular disease, and substance abuse. Any of these consequences can lead to hospitalization, disability, or death.

Intimate partner violence is actual or threatened physical, sexual, psychological, or emotional abuse by a current or former spouse (including common-law spouse), dating partner, or boyfriend or girlfriend. Intimate partners can be of the same or opposite sex. Nearly 25% of women have been raped and/or physically assaulted by an intimate partner, and more than 40% of the women who experience partner rapes and physical assault sustain a physical injury. Women experience more chronic and injurious assaults from intimate partner violence than men.

Sexual violence is committed by an intimate or non-intimate perpetrator such as a spouse, family member, person in position of power or trust, friend, acquaintance, or stranger. Although there is some overlap between intimate partner violence and sexual violence, sexual violence is committed by a wider range of perpetrators. Sexual violence includes completed or attempted sex acts against the victim's will or involving a victim who is unable to consent; abusive sexual contact; and non-contact sexual abuse, including sexual harassment. Women are the primary victims of sexual violence. Approximately 15% to 25% of women experience an attempted or completed rape at some time in their lives. More than half of the women reporting rape are sexually assaulted before age 18.

Child maltreatment is any recent act or failure to act resulting in imminent risk of death, serious physical or emotional harm, sexual abuse, or exploitation of a child by a parent or caretaker who is responsible for the child's welfare. Much of the child maltreatment field divides child maltreatment into four categories: physical abuse, child neglect, sexual abuse, and emotional abuse (e.g., psychological or verbal abuse; mental

Victims of violence can experience physical injury, adverse mental health consequences, and harmful physical health consequences.

injury). In the United States, child protective services identify more than 825,000 children annually as victims of maltreatment. Childhood exposure to maltreatment, parental violence, and other adverse experiences is associated with risky behaviors, such as smoking, overeating, suicidal behavior, and perpetrating youth and intimate partner violence, and with negative health outcomes such as heart disease and cancer.

These three types of violence are interrelated. They share common risk and protective factors and often co-occur within the same households.

Elder abuse is an emerging problem that may usefully be studied alongside intimate partner violence, sexual violence, and child maltreatment. Although data are poor, the best national estimate is that nearly 450,000 people ages 60 and older experienced abuse and/or neglect in domestic settings in 1996. Of these cases of abuse, only 16% (nearly 71,000) were reported to and substantiated by Adult Protective Service (APS) agencies; the remaining 379,000 were either not reported to APS or not substantiated.

The Injury Center’s Niche in Preventing Intimate Partner Violence, Sexual Violence, and Child Maltreatment

Many agencies and organizations have developed programs to prevent violence against women and children. As noted in the Institute of Medicine report *Reducing the Burden of Injury*, however, very few of these programs have been evaluated rigorously to assess their effectiveness and to determine which among them merit widespread adoption. CDC’s Injury Center provides leadership in developing and assessing the effectiveness of violence prevention programs and policies.

Numerous federal agencies conduct research about many aspects of intimate partner violence, sexual violence, and child maltreatment. In its work, the Injury Center emphasizes research with direct implications for prevention. This research perspective complements the work of other federal agencies. For example, the Injury Center’s focus on identifying ways to prevent the development of perpetration of intimate partner violence, sexual violence, and child maltreatment complements the U.S. Department of Justice’s focus on persons already charged with violent offenses associated with these behaviors. The Injury Center’s focus on applied dimensions of prevention in these areas complements the National Institutes of Health’s focus on basic scientific questions.

CDC’s Injury Center provides leadership in developing and assessing the effectiveness of violence prevention programs and policies.

Currently, efforts to prevent or intervene in intimate partner violence, sexual violence, and child maltreatment focus on reducing victims' risks for future violence and on mitigating the consequences of exposures to such violence. The field is dominated, therefore, by an emphasis on secondary and tertiary prevention strategies tailored to victims. Many leaders in the field are calling for greater attention to primary prevention of intimate partner violence, sexual violence, and child maltreatment. To prevent these types of violence from occurring in the first place, researchers and practitioners must place greater emphasis on approaches directed at perpetrators and potential perpetrators. Many questions, especially about young perpetrators, remain unanswered, seriously hindering the development and identification of effective violence prevention strategies. Thus, even though research on perpetration is still in the foundational stage, it is essential that the Injury Center focus on perpetration research to support future development of effective prevention programs. Parallel efforts must continue to prevent re-victimization.

The Injury Center's Research Priorities in Preventing Intimate Partner Violence, Sexual Violence, and Child Maltreatment

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the seven most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks.

Priorities

A.* Evaluate strategies to disseminate and implement science-based parenting interventions to prevent child maltreatment.

Research has shown that parenting interventions can reduce and prevent child maltreatment. For these interventions to reach the broadest audience possible, more applied research about their dissemination and implementation is necessary. For example, a program's effectiveness may vary depending on the setting in which it is delivered; research should examine the impact of

delivering parenting programs in a variety of specific settings, such as the work place and primary care settings, and through the media. Research to guide the adaptation of interventions to specific communities, subcultures, and populations will further enhance their effectiveness.

Victims of child maltreatment are at risk for other types of violence later in life, including youth violence, suicide, and intimate partner violence. Therefore, it is plausible that parenting interventions may also reduce the likelihood of experiencing these other types of violence.

B.* Evaluate the efficacy and effectiveness of interventions and policies to prevent perpetration of intimate partner violence, sexual violence, and child maltreatment.

The key to preventing intimate partner violence, sexual violence, and child maltreatment is to intervene with individuals, families, and communities in ways that stop the perpetration of violent behaviors. Programs and policies that provide counseling for batterers, improve parenting skills, or prevent dating violence, for example, intervene with perpetrators and potential perpetrators *before* the violence occurs or recurs. Research should focus on evaluating these programs and policies with a particular emphasis on those that attempt to address two or more types of perpetration simultaneously. Identifying programs and policies that can effectively address multiple types of perpetration will facilitate a more efficient allocation of prevention resources. Further, large public demand exists for effective programs and policies in this area.

C.* Identify social norms that support intimate partner violence, sexual violence, and child maltreatment and evaluate strategies to change them.

Research has demonstrated the importance of changing social norms to reduce major public health problems such as smoking and HIV. In some social contexts, intimate partner violence,

Research has shown that parenting interventions can reduce and prevent child maltreatment. More applied research about their dissemination and implementation is necessary.

Research has demonstrated the importance of changing social norms to reduce major public health problems.

sexual violence, and child maltreatment are considered normative behavior. To design effective interventions, researchers must first identify the particular social norms and beliefs that support these types of violence and then find ways to alter or replace them with ones that prevent violence. Even when such violent behaviors are not considered “acceptable,” cultural attitudes and beliefs may exacerbate these problems by blaming victims or by supporting attitudes and behaviors that create social atmospheres conducive to, or tolerant of, such violence. Given CDC’s role in addressing the contribution of social norms to other public health problems, the Injury Center—as part of CDC—is well-positioned to address this research opportunity. Research about social norms related to intimate partner violence, sexual violence, and child maltreatment will also apply to other forms of violence.

D.* Evaluate training programs about intimate partner violence, sexual violence, child maltreatment, and elder abuse for health professionals.

According to the Institute of Medicine, programs to train health professionals about intimate partner violence, sexual violence, child maltreatment, and elder abuse have received insufficient attention and evaluation. Few studies investigate whether curricula have the desired impact on delivery of health care to victims. Evaluation research is needed to determine the impact of training programs on the practices of health professionals as well as their effects on victims. Factors that affect the development, implementation, and maintenance of such programs include the nature of accreditation, licensure, and certification; characteristics of health professional organizations; views of the stakeholder groups; attitudes of health professionals; and the existence of mandatory laws and education requirements. It is also important to consider whether a health professional’s own experience with violence may influence his or her response to victims and to identify training strategies that account for that influence.

E.* Evaluate the health consequences of intimate partner violence, sexual violence, and child maltreatment victimization across the life span.

Research has linked intimate partner violence, sexual violence, and child maltreatment to a wide range of negative health outcomes and risk behaviors. However, little information exists about the mechanisms that may be responsible for these negative outcomes or the factors that may diminish them. Further understanding of the relationship between victimization and various health outcomes is important to guide interventions. Research in this area will guide development of interventions tailored to victims' needs.

F.* Examine the development of intimate partner violence, sexual violence, and child maltreatment perpetration to identify at-risk populations, modifiable risk and protective factors, and optimal times and settings for intervention.

Ultimately, the cause of and responsibility for intimate partner violence, sexual violence, and child maltreatment lie with the perpetrators. Programs and policies that address the needs of victims (including same-sex victims), while critically important, fail to address the root causes for the behaviors that lead to the violence. However, important knowledge about these root causes is lacking. To understand how the propensity to behave violently toward partners and children develops, researchers must follow study populations for extended periods. A better understanding of the developmental pathways and social circumstances that contribute to perpetration will greatly enhance the development of effective primary prevention programs and guide refinement of existing prevention programs. Research about the development of perpetration may also apply more broadly to areas of youth violence and suicide prevention because of their association with intimate partner violence, sexual violence, and child maltreatment.

To understand how the propensity to behave violently toward partners and children develops, researchers must follow study populations for extended periods.

G.* Develop and evaluate surveillance methods for intimate partner violence, sexual violence, and child maltreatment.

Few data are available to monitor intimate partner violence, sexual violence, and child maltreatment, and those that exist are of questionable validity and reliability; better tracking and monitoring methods are necessary to support prevention efforts. To develop better surveillance systems, research should determine the sensitivity and specificity of alternative definitions, the utility of alternative surveillance methodologies, and the validity and reliability of the specific measures. Biomechanics research may be useful in diagnosing intimate partner violence and child maltreatment, identifying specific injuries that are highly predictive of these types of violence and establishing appropriate case definitions. Data sources for information about intimate partner violence, sexual violence, and child maltreatment differ to some extent, so evaluation of the methods for each must frequently be done independently. Improved surveillance methods will render better information to guide program development and evaluation. Because states and localities often lack adequate monitoring systems, research findings will be particularly valuable to them as they expand their efforts to address violence as a public health issue.

H. Evaluate strategies to disseminate information about preventing intimate partner violence, sexual violence, and child maltreatment.

Dissemination of research findings is especially important to guide prevention and intervention activities, but little research to assess alternative dissemination strategies has been done in the violence prevention field. Moreover, information dissemination activities present many opportunities for collaboration with agencies and organizations working to prevent intimate partner violence, sexual violence, and child maltreatment. It is important to identify and evaluate methods to facilitate collaboration across advocacy, consumer, research, and practice settings in conducting dissemination. Encouraging collaboration among these groups is necessary to maintain the public's interest and meet policy makers' need for information to guide development of appropriate policies, legislation, and litigation procedures.

The prominence of the Rape Prevention and Education Grant Program (RPE), administered by the Injury Center, presents a unique opportunity to test models of dissemination through the sexual violence service infrastructure. The RPE distributes funds to states to support sexual violence prevention services and programs. It is crucial that state programs have access to and distribute the most up-to-date information. Research should identify the most effective strategies for translating and disseminating knowledge about sexual violence victimization and perpetration.

I. Evaluate the efficacy and effectiveness of interventions and policies for preventing intimate partner violence, sexual violence, and child maltreatment victimization and its consequences.

Federal, state, and local government agencies and private organizations currently invest many resources in services for battered and sexually assaulted women and maltreated children. It is critically important to determine the effectiveness of these programs and policies in preventing victimization and its consequences. This type of research can help agencies and organizations that provide victim services determine whether their investments actually reduce violence and maltreatment.

Intimate partner violence, sexual violence, and child maltreatment often overlap in families, so evaluating the effectiveness of programs and policies that address two or more of these behaviors simultaneously is of high priority. Identifying programs that can effectively address multiple types of victimization (including same-sex violence) at once will facilitate a more efficient allocation of prevention resources. One area requiring particular attention is the evaluation of screening instruments for intimate partner violence, sexual violence, and child maltreatment used in health care and social service settings to identify victims needing additional services.

J. Evaluate models for integrated community responses to intimate partner violence, sexual violence, and child maltreatment.

Collaboration among various members of a community and various groups working in intimate partner violence, sexual violence, and child maltreatment prevention is essential to preventing such violence. Expanding prevention research to include the development of integrated community responses to these public health problems will significantly advance prevention and intervention research. Further development of integrated community responses depends largely on advances in effectiveness research about specific prevention policies and interventions.

K. Examine the development of intimate partner violence, sexual violence, and child maltreatment victimization to identify at-risk populations, modifiable risk and protective factors, and optimal times and settings for intervention.

The Injury Center's mission of violence prevention emphasizes primary prevention of intimate partner violence, sexual violence, and child maltreatment. Currently, many research efforts focus on secondary or tertiary prevention, that is, preventing revictimization. Research is needed to identify the different risk and protective factors related to victimization in order to prevent first-time victimization. In addition, research should explore the commonalities and differences among risk factors for victimizations involving these kinds of violence.

To understand the characteristics that place people at risk of victimization, researchers must follow study populations for extended periods. Longitudinal research helps researchers specify optimal times and methods for intervention and prevention. For example, research indicates that early exposure to violence in the home can lead to future risk of victimization. Identifying potential moderators will aid in designing prevention programs. Longitudinal research can also identify patterns of coping and resilience across the life span for victims of intimate partner

Research is needed to identify risk and protective factors related to victimization in order to prevent first-time victimization.

violence, sexual violence, and child maltreatment; this information can enhance prevention and intervention activities. As with preventing perpetration, a better understanding of the risk factors associated with victimization would greatly enhance the development of effective primary prevention programs.

L. Identify risk and protective factors and effective prevention strategies for elder abuse.

Elder abuse is an emerging area of public health concern. As the population ages, this form of abuse may become a much greater problem. Little research about risk and protective factors for elder abuse victimization and perpetration currently exists. Risk factors appear to differ according to the type of elder abuse; physical and psychological abuse, for example, share risk factors that are distinct from those for neglect and financial abuse. Absent important foundational research, program development is difficult. Similarly, little information is available about the effectiveness of existing interventions to prevent elder abuse and mitigate its consequences. Given the limited body of scientific knowledge about elder abuse, this is an important priority for the future.

M. Study the role(s) of substance use and abuse as precursors to and consequences of intimate partner violence, sexual violence, and child maltreatment victimization and perpetration.

Researchers do not clearly understand the roles of substance use and abuse as precursors to and consequences of victimization and perpetration across intimate partner violence, sexual violence, and child maltreatment. Studies investigating substance use and its co-occurrence with perpetration of and victimization by these types of violence should identify key components for prevention and intervention programs. Other federal agencies such as the National Institute of Drug Abuse and the Substance Abuse and Mental Health Services Administration support research and programs in this area. Injury Center research activities should complement the efforts of these agencies whenever possible.

N. Evaluate the impact of extreme community and environmental stressors on intimate partner violence, sexual violence, and child maltreatment.

Natural and man-made disasters such as floods and terrorism may exacerbate intimate partner violence, sexual violence, and child maltreatment in affected communities. Research should assess the impact of community and environmental stressors on these three types of violence. Findings from this research can aid service agencies as they develop appropriate responses during periods of extreme stress. Injury Center research on this issue would complement other CDC work related to disaster response and terrorism.

O. Describe service delivery use, impact, and costs of interventions for intimate partner violence, sexual violence, and child maltreatment.

Better information about service delivery use, impact, and costs of interventions for intimate partner violence, sexual violence, and child maltreatment is needed to support research about the cost effectiveness of interventions and policies designed to prevent these problems and their consequences. This research will become more important as more information about the efficacy and effectiveness of prevention programs and policies becomes available.

Preventing Suicidal Behavior

Public Health Burden

Injury from suicidal behavior is a major public health problem in the United States. In 1999, suicide was the eleventh leading cause of death overall in the U.S.; it was the third leading cause of death among people ages 15 to 24 and second among people ages 25 to 34. Although suicide is a problem among youths and young adults, rates of death due to suicide continue to be highest among people ages 65 and older.

The number of completed suicides reflects only a small portion of the impact of suicidal behavior. Many more people are hospitalized as a result of nonfatal suicide attempts than are fatally injured, and a still greater number are treated in ambulatory settings or are not treated at all for injuries resulting from suicidal acts. Data from the 1999 Youth Risk Behavior Survey indicate that 8.3% of all high school students reported attempting suicide in the 12 months before the survey, which translates into approximately 1.3 million students across the U.S. Prior studies have also shown a high prevalence of nonfatal suicidal behavior among adults. According to data from the National Hospital Ambulatory Medical Care Survey, an estimated 671,000 visits were made to U.S. hospital emergency departments for self-directed violence in 1998. Other research indicates that more than 70% of people who attempt suicide never seek health services afterwards. As a result, prevalence figures based on health records substantially underestimate the societal burden of suicidal behavior.

The Injury Center seeks to develop and promote the widespread adoption of policies and practices that effectively prevent suicide and suicidal behaviors.

The Injury Center's Niche in Preventing Suicidal Behavior

Injuries and deaths resulting from self-directed violent behaviors represent a substantial drain on the economic, social, and health resources of the nation. The Injury Center seeks to lessen these burdens by developing and promoting the widespread adoption of policies and practices that effectively prevent suicide and suicidal behaviors. A center within CDC, the Injury Center is uniquely positioned to address the need for effective, population-based prevention and intervention strategies.

Currently, however, public perceptions that suicide is solely a mental health issue and a lack of scientific knowledge about effective population-based strategies hinder efforts to intervene and prevent suicide.

To address these challenges, the Injury Center draws on historical strengths and continues to expand into areas where suicide experts have identified substantial needs that the Injury Center should address. These activities fall into four categories:

- Disseminating information about suicidal behavior and its prevention by supporting the implementation of proven programs and policies.
- Applying scientific methods to evaluate the effectiveness of current intervention and prevention programs.
- Enhancing the knowledge base about risk and protective factors and the consequences of suicidal behavior in order to develop more effective prevention strategies.
- Continuing to improve methods for data collection in order to describe and track suicidal behaviors.

The Injury Center works with a variety of partners at the local, state, and national levels to disseminate scientific information about suicide prevention. These efforts are directed to the public, policy makers, health departments, community-based organizations, and other entities. By promoting research that addresses the information needs of constituents, the Injury Center contributes substantially to encouraging widespread adoption of effective suicide prevention strategies.

Many communities have implemented a wide range of programs that attempt to reduce injuries and deaths resulting from self-directed violence. Little is known, however, about the effectiveness of these programs. Finding successful strategies, especially those that focus on developing positive skills and social relationships, may also have a broad impact on an array of violent behaviors. Given the Injury Center's ongoing activities in child maltreatment, youth violence, and intimate partner violence prevention, it is in a unique position to support the development and evaluation of programs that address suicide and interpersonal violence prevention within an integrated framework. In addition, while research has identified many important risk and protective factors for suicidal behavior, studies have rarely investigated the

interaction between these factors. Developing a better understanding of the dynamics of suicidal behavior is essential for building effective interventions.

Several other federal agencies and national organizations focus significant research efforts on understanding the causes of suicidal behavior and its prevention. The Injury Center collaborates regularly with these groups as evidenced by the recent release of the Surgeon General's *National Strategy to Prevent Suicide*. The Injury Center's contributions to suicide prevention highlight public health interventions and broad-based strategies that complement important mental health research and treatment efforts conducted by key federal partners at the National Institute of Mental Health and the Substance Abuse and Mental Health Services Administration.

The Injury Center's Research Priorities in Preventing Suicidal Behavior

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the seven most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks.

Priorities

Researchers currently know very little about the ways that broader political and social processes affect the creation and implementation of large-scale suicide prevention plans and activities.

A.* Develop, evaluate, and institutionalize processes for creating and implementing suicide prevention activities.

Many state and local health departments and other agencies across the U.S. are developing community, regional, or statewide suicide prevention plans and implementing them across their jurisdictions. However, researchers currently know very little about the ways that broader political and social processes affect the creation and implementation of large-scale suicide prevention plans and activities. To foster the widespread adoption of effective programs and policies, researchers must examine how states and communities develop suicide prevention plans; study how agencies establish cooperation and coordination across

agencies; identify key infrastructure requirements for plan adoption; recognize barriers to universal implementation; and develop strategies to overcome these barriers to enhance the power of implementation. By supporting research addressing these key issues, the Injury Center can contribute to the larger effort to plan for and establish effective suicide prevention activities at the local, state, and national levels.

B.* Evaluate the impact of restricting access to lethal means used in suicidal behavior.

Research indicates that the means used in suicidal behavior (e.g., jumping from a bridge or using a firearm versus taking pills) has a substantial impact on whether the act results in significant injury or death. When people have easy access to highly lethal means, the likelihood of serious injury and death increases. Early evidence suggests that restricting access to specific means used in suicidal behavior (e.g., installing bridge barriers) can reduce overall rates of suicide-related death and injury. Debates about this strategy continue because the majority of means-restriction policies and interventions have not been tested.

Additionally, there is a substantial gap in scientific knowledge about how suicidal individuals choose among means. Previous research has shown that without ready access to lethal means, some individuals will choose not to engage in a suicidal act or will be more likely to survive their injuries; however, some subset of suicidal individuals will substitute other means. This substitution may shift the death from one cause category to another rather than preventing it. Researchers can better understand the potential impact of means-restriction interventions by learning more about how individuals make choices about the means they use. Furthermore, if researchers demonstrate that means-restriction policies effectively reduce suicide mortality and serious injury, additional investigation will be necessary to learn how to increase the acceptability of these policies so they can be implemented nationwide.

C.* Evaluate whether interventions proven to reduce other forms of violence can also prevent suicidal behavior.

Researchers have documented the success of several different types of intervention strategies designed to reduce behaviors that are either risk factors for suicidal behavior (e.g., child abuse and neglect, alcohol and drug abuse) or outcomes with similar risk factor profiles (e.g., youth interpersonal violence). Especially promising among them are comprehensive parenting programs that provide usable knowledge to parents of young children and adolescents and improve child-rearing skills, and positive health promotion strategies that seek to enhance social competency, conflict management, and coping skills.

Given the overlap between suicide and other behavioral problems, such strategies show strong potential for preventing suicidal behaviors. But few, if any, evaluations of these programs have examined the direct impact on suicidal behaviors. At present, the lack of well-designed suicide prevention and intervention research that can demonstrate an effective reduction in suicidal behaviors is a major deficiency in the field. Including suicide prevention in interventions for behavioral health threats that overlap with suicide has the potential to bring a wide range of physical and emotional health benefits to the population. In addition, by examining proven prevention programs that target common risk or protective factors for suicidal behavior, researchers can build on existing programs to make more efficient use of limited resources and eliminate potential redundancies.

D.* Evaluate the efficacy and effectiveness of interventions to prevent suicidal behavior.

Arguably, the greatest challenge in the field of suicide prevention is identifying strategies and programs that actually reduce the occurrence of suicide-related death and injury. In their attempts to respond to community concerns about self-directed violence, many public and private organizations have rushed to implement suicide prevention activities. These activities include interventions to increase primary care providers' awareness of suicide as a

problem and to promote patient screening for suicidal thoughts and suicide attempts. Other efforts focus on strategies implemented after a crisis or traumatic event has occurred. Although several types of interventions have been developed for use in schools and other specific settings after a suicide, research does not appear to support the claim that such efforts prevent additional suicidal behavior. Furthermore, while adult males ages 25 to 50 make up the majority of suicide deaths, few interventions focus specifically on this group.

In sum, little is known about whether current approaches effectively reduce injuries and deaths resulting from self-directed violence. Because many programs are already in place, they represent a significant opportunity to study prevailing practices and demonstrate their impact on suicidal behavior. As researchers evaluate these activities, they can also improve methods for identifying promising strategies and programs.

The many programs already in place represent a significant opportunity to study prevailing practices and demonstrate their impact on suicidal behavior.

E.* Clarify the influence of contextual forces on rates of suicidal behavior.

Previous research indicates that a variety of non-mental health factors can significantly affect rates of suicidal behavior and completed suicides. These are societal- and community-level factors such as the structure of social relationships (e.g., the percentage of people in the community who are involved in religious activities); changes in the economy; community norms, values, and attitudes; and the availability of resources for people who are struggling with day-to-day difficulties. The evidence also suggests that these influences can vary in their presence and impact across demographic groups. Researchers do not clearly understand the mechanisms through which these broad, community-level factors affect rates of suicidal behavior, which hinders their ability to design effective prevention strategies. Researchers, practitioners, and public health agencies need this information to design and test more population-based approaches that will effectively reduce suicide-related injuries and deaths in particular communities.

F.* Clarify the impact of individual-level risk and protective factors on suicidal behavior.

While individual mental health problems can contribute substantially to suicidal behavior, mental disorder alone does not cause it. Numerous additional factors may increase the risk of suicidal behavior in some individuals. These include stressful life events such as the death of a relative or losing a job; ongoing difficulties such as child maltreatment, bullying, intimate partner violence, physical illness or disability; and social isolation characterized by living alone and having few or no social supports. But researchers still lack insight into how these problems affect suicide risk. Under some conditions, difficult life events appear to motivate individuals to develop more effective coping skills, thereby enhancing protection against suicidal behaviors. Current research perspectives, however, generally fail to acknowledge these challenges as possible opportunities for suicide prevention. As a result, very little is known about how to recognize and bolster potentially protective effects.

In addition to life stresses and social isolation, other individual-level problems such as substance use or abuse and a tendency toward impulsive behavior significantly increase the risk of suicidal behavior. As with life events and interpersonal difficulties, though, it is not clear how and under what conditions substance use or abuse and impulsiveness may increase the likelihood of suicidal behavior. More research is needed to understand the individual-level dynamics of suicidal behavior, in particular, how ongoing stresses, difficult events, interpersonal and familial relationships (including parenting practices), as well as impulsiveness and substance use or abuse, affect the likelihood of suicide across the life span. The Injury Center would contribute substantially to the development of effective interventions by bringing a more dynamic and socially informed understanding of suicidal behavior into risk and protection research.

G.* Develop better methods for collecting data about fatal suicides, nonfatal suicidal acts, and related behaviors.

Having accurate, timely, and accessible information about suicidal behaviors is crucial, both for tracking the problem of suicide and for evaluating the effectiveness of interventions. Information should include data about suicidal behaviors that result in death, hospitalization, or outpatient medical treatment, as well as those where no medical care is sought. Currently, national data about self-directed violence are limited almost exclusively to fatalities; however, estimates indicate that for each suicide fatality, approximately 20 people may be seen in hospital emergency departments for attempted suicide. The Injury Center is working to enhance the quality of suicide injury data collected from hospital emergency departments, but very little is known about injuries due to suicidal behaviors that are treated in other settings or not treated at all.

Additionally, there is general consensus that official fatality data underestimate the number of suicide deaths and that there may be differential undercounting among groups, such as women, with relatively low suicide rates. To create and implement enhanced surveillance strategies, researchers must refine and validate current definitions of suicide, attempted suicide, and related behaviors; develop better methods for implementing high-quality, timely data collection systems (including data systems outside of the health and medical community); and evaluate the utility, quality, and efficiency of the data and collection procedures.

H. Develop and evaluate methods to disseminate information about effective suicide prevention strategies and interventions.

As effective suicide prevention strategies and interventions are recognized, it will become increasingly important to identify successful methods and mechanisms for disseminating and encouraging the adoption of those evidence-based interventions. Research is needed to identify key audiences for programs, uncover the best formats and channels for providing information to ensure that it is useful, and assess the level and kinds of training and technical assistance required for successful implementation.

Having accurate, timely, and accessible information about suicidal behaviors is crucial, both for tracking the problem of suicide and for evaluating the effectiveness of interventions.

At present, little is known about the role and impact of specific models for distributing information about and support for interventions to prevent suicidal behavior and intentional, self-inflicted injuries. By supporting this line of research, the Injury Center will fulfill its role in promoting the widespread adoption of successful suicide prevention programs.

I. Examine how effective interventions can be modified for diverse and culturally distinct populations.

Accumulated research evidence indicates that rates of suicidal behaviors and suicide risk profiles can vary widely among distinct social and cultural groups. For example, among American Indians, some subgroups have severely elevated levels of suicide mortality; African American females have especially low rates of suicide mortality, but they may have high rates of nonfatal suicidal behavior. It is not clear whether gay, lesbian, bisexual, and transgendered youths have elevated levels of nonfatal suicidal behavior because findings from different studies have been contradictory. These rate disparities suggest that there is wide variation in suicide risk across social and cultural groups. In addition, risk and protective factors may affect suicidal behavior differently in specific populations.

Intervention strategies must be robust enough to account for social and cultural differences because such variations may affect the impact of prevention activities. Strategies that are effective with one group either may not be effective with others or may need to be tailored in particular ways to maintain their effectiveness and ensure that they are culturally acceptable. Presently, however, a substantial gap exists in the knowledge about how to translate interventions across groups or contexts while ensuring that modifications do not compromise the intervention's essential components. Studies must examine how social and cultural factors such as stigma, beliefs about suicide and suicide acceptability, and social and cultural history might alter how a community views an intervention. Understanding how to modify strategies proven effective in other settings will improve substantially the likelihood that interventions will be acceptable to diverse communities.

Studies must examine how social and cultural factors might alter how a community views an intervention.

J. Create and evaluate new communication campaigns for suicide prevention.

Experts believe that greater public understanding of suicide would enhance prevention efforts. It is important to raise awareness about key risk factors for suicide, emphasize the fact that suicidal behavior is preventable, and reduce the stigma associated with seeking help for suicidal feelings. To accomplish these tasks, researchers and practitioners need to know more about how to construct general and targeted public education campaigns to maximize their beneficial effects; that is, identify the messages that work as well as the audiences for which those messages are effective. Campaigns should also be evaluated to determine whether they have a substantial impact on audiences' understanding of and beliefs about suicidal behavior. Evaluation findings will be useful in refining communication messages to enhance their impact.

K. Evaluate the influence of news and entertainment media on suicidal behavior.

Research supports the potential for “contagion” effects of factual news stories about suicidal behavior, particularly among youths and young adults, but the effect of fictional portrayals on vulnerable individuals is unclear. Specifically, research is needed to understand how both fictional and nonfictional media accounts influence individuals to engage in suicidal behavior, as well as how to construct messages and portrayals that discourage suicidal behavior.

L. Clarify the relationship between suicidal thoughts and feelings and suicidal behavior.

Thoughts of suicide, whether or not expressed to others, often precede suicidal acts. Researchers typically conceptualize the range of suicidality as a continuum extending from ideas and thoughts about suicide that are not acted upon to nonfatal suicidal acts to completed suicide. The process through which individuals move from thought to action, however, remains unclear. Few who experience suicidal ideas and thoughts engage in self-injurious

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behavior, and even fewer die from these behaviors. Evidence suggests that some subgroups of individuals grapple repeatedly with suicidal ideation and may make numerous nonfatal attempts. While identifying individuals struggling with suicidal ideation presents an important opportunity for intervention, better knowledge about how ideation moves into action—both for the first time and over the course of repeated acts—will help researchers develop intervention strategies that can counter the process more effectively.

M. Quantify the social and economic costs of suicidal behavior.

Fatal and nonfatal suicidal behaviors result in significant medical, economic, and social costs, including lost wages and trauma for family members and friends. Little research, however, has focused on quantifying the total costs of suicidal behavior in the U.S., in either monetary or nonmonetary terms. The definition of nonmonetary costs such as pain, suffering, and reduced quality of life needs further exploration and refinement. Such information would be useful for educating the public about the need for prevention as well as for assessing the cost-effectiveness of prevention programs.

N. Examine how characteristics of specific institutional settings affect risk for suicidal behavior and evaluate the effectiveness of interventions designed to reduce risk in these settings.

Relatively little is known about how the physical and social characteristics of specific institutional settings such as schools and jails can heighten or lessen the risk of suicidal behavior. More research is needed to understand how suicidal individuals may or may not be recognized within specific social and institutional settings. Researchers also need to examine the organizational or institutional factors that facilitate effective interventions when suicidal individuals are identified. Such factors include physical features of the environment that allow staff to monitor students or clients effectively and students' or clients' abilities to access means for engaging in suicidal behavior.

O. Determine the long-term consequences of nonfatal suicidal behavior.

There is substantial evidence that individuals who die from suicide often have a history of previous suicide attempts. Yet little research exists about the long-term outcomes of nonfatal suicidal behavior. Studies are needed to follow suicidal individuals to determine whether suicidal thoughts and behaviors are likely to abate over time, and if so, to identify the factors that increase the likelihood of diminution.

Little research exists about the long-term outcomes of nonfatal suicidal behavior.

Preventing Youth Violence

Public Health Burden

Homicide is the second leading cause of death among 15- to 24-year-olds overall.

Youth violence, perpetrated both by and against young people, results in enormous physical, emotional, social, and economic consequences. Although youth violence has declined significantly in recent years, much work remains to reduce this public health burden. Homicide is the second leading cause of death among 15- to 24-year-olds overall. In this age group, homicide is the number one cause of death among African Americans, the second leading cause of death among Hispanic Americans, and the third leading cause of death among American Indians. In 1999, 4,998 youths ages 15 to 24 were murdered—an average of 14 per day. This represents approximately one third of all homicide victims that year. Among the homicide offenders in 2000 whose age was known by authorities, approximately 48% were age 24 or younger, and 9% were younger than 18. Guns are a factor in most youth homicides. In 1999, 81% of homicide victims ages 15 to 24 were killed with firearms.

Violence is also an important cause of nonfatal injuries among young people. Between 1992 and 1998, young people ages 12 to 24 were 14 times more likely than adults 50 and older to be injured as a result of a violent crime. Although nonfatal acts of violence are relatively common on school property, most acts of serious and fatal violent crime occur outside of school. For instance, less than 1% of all violent deaths among school-age children occur in schools. These data highlight the need for prevention programs that address risk for violent behaviors both on and off school property, including school-, family-, and community-based programs.

The Injury Center's Niche in Preventing Youth Violence

For many years, the predominant approach to youth violence was reactive; disproportionate attention and resources were given to the medical treatment of injured victims and the apprehension and incarceration of violent offenders. A public health approach brings emphasis and commitment to identifying policies and programs to *prevent* youth violence. It derives from a tradition of collaboration among a broad spectrum of scientific disciplines, organizations, and communities to solve the problem of violence. In particular, the health sector, including

emergency departments and community health agencies, plays a prominent role as a source of data and a potential site for interventions to prevent future violence. The public health approach also highlights the potential utility of applying a variety of scientific tools (e.g., the tools of epidemiology, behavioral and social sciences, and engineering) explicitly toward identifying effective prevention strategies. In these key ways, the perspective and methods of public health complement those of criminal justice and other sectors in understanding and responding to violence.

CDC's Injury Center is dedicated to studying interpersonal and self-directed violence, including youth violence, intimate partner violence, child maltreatment, and suicidal behavior. Research has documented strong links among youth violence, family violence, and suicidal ideation. The Injury Center's inclusive focus on a range of violence-related injuries provides a unique opportunity to better understand and address the linkages between youth violence and other forms of violence.

The Injury Center's violence prevention research is intended to have practical implications and immediate relevance for prevention. For example, studies about risk and protective factors are conducted to guide prevention programs and policies. The Injury Center's evaluation studies focus on determining not only how well programs work but also on identifying the processes through which they have an impact. This information is crucial to dissemination efforts so that schools and communities can implement programs effectively.

Several other federal agencies, including the Departments of Education and Justice, the National Institute for Occupational Safety and Health, and the National Institutes of Health study the causes and consequences of youth violence and work to prevent it. The Injury Center routinely collaborates with these and other agencies to study youth violence and to ensure that research findings are applied to practice. For example, recent partnerships with the Departments of Education and Justice have facilitated studies about school-associated violent deaths and nonfatal injuries from violent crimes such as assault, robbery, and rape. The Injury Center's research on violence-related injuries across contexts (e.g., school, family, community), roles (i.e., victim or perpetrator), and proximal causes (e.g., intoxication, bullying, robbery), combined with its emphasis on prevention strategies, complements and extends the violence-prevention activities of other federal agencies and community-based organizations.

The Injury Center's violence prevention research is intended to have practical implications and immediate relevance for prevention.

The Injury Center’s Research Priorities in Preventing Youth Violence

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the seven most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks.

Priorities

A.* Evaluate dissemination strategies for the most effective youth violence prevention programs.

Research has identified several individual-, family-, and school-based approaches that effectively reduce youth violence and aggression, some of which have also demonstrated effectiveness in different settings and with different populations. Youth violence prevention research should move beyond conducting efficacy and effectiveness studies to conducting research that identifies ways to disseminate the most effective strategies while maintaining the benefits of original programs. Studies should investigate factors that influence a program’s acceptability, adoption, safety, and costs. These issues are critical for implementing programs with “fidelity,” that is, in the manner in which they are thought to be most effective. As described in the Surgeon General’s report on youth violence, “more research is needed on how to implement youth violence prevention programs with fidelity . . . how to monitor program fidelity . . . and how to increase community and agency capacity for implementing these programs.”

Although dissemination research in youth violence prevention is underdeveloped, researchers and community organizations that have collaborated to develop and evaluate programs are increasingly seeking opportunities to facilitate wider dissemination of effective programs. Researchers should study methods to improve adoption of proven youth violence prevention programs. Necessary steps are to identify programs and strategies that rigorous evaluation has demonstrated to be

Researchers should study methods to improve adoption of proven youth violence prevention programs.

effective and then to assess current practice to discover where research and practice diverge. Research about bridging this gap in dissemination practice is critical to improving the ability to disseminate the most effective violence prevention strategies.

B.* Evaluate the effectiveness of community-wide parenting programs for youth violence prevention.

Several recent documents, including CDC's *Best Practices of Youth Violence Prevention* and *Youth Violence: A Report of the Surgeon General*, highlight the benefits of parenting programs. The substantial evidence for the link between parenting practices and youth risk for violence, as well as the increasing evidence that parenting practices are modifiable, supports the need for research investigating prevention strategies that affect families on a broad level.

Research in this area would further knowledge about family-level interventions that reduce youth violence and would provide strategies for influencing families and parenting. This line of research would build on the knowledge gained from evaluating existing parenting interventions to support the development and evaluation of public health-oriented parenting programs. These programs should be comprehensive and population based, and they should include multiple levels of intervention. For early childhood interventions, research should include long-term evaluations of their impact on youth violence.

C.* Evaluate the effectiveness of youth violence prevention strategies.

Many communities and schools are implementing violence prevention strategies with little empirical evidence of their effectiveness. Research is needed to examine the effectiveness of these programs in “real-world” circumstances. It is also important to evaluate emerging community-based programs to prevent youth violence as well as programs that effectively prevent other problem behaviors such as drug abuse, which may influence youth risk for violent victimization or perpetration. The potential to

Ongoing monitoring of the practices, interventions, and policies that communities and schools adopt is essential.

identify effective programs for preventing multiple problems, for example drug abuse and violence, provides an opportunity for cross-agency collaboration. It may also be cost effective—schools and community-based organizations can address more than one problem with the same time and resources. Research should provide information about the cost effectiveness of prevention programs and generate tools for schools and communities to use to evaluate the effectiveness of their programs.

Research should evaluate the preventive impact of the most promising programs for which efficacy data are available, as well as programs that lack efficacy data but are being implemented widely. Ongoing monitoring of the practices, interventions, and policies that communities and schools adopt is essential.

D.* Identify and evaluate strategies to decrease inappropriate access to and use of firearms among youths.

Firearms are used in the majority of youth homicides. In addition, many youths carry and use firearms to intimidate their peers and may or may not intend to harm others. While much is known about the prevalence and correlates of inappropriate gun carrying among youth and the consequences of youth gun use, less is known about the factors associated with youth access to firearms and use of firearms to threaten or injure others. Research about gun carrying is needed to improve existing strategies, to develop novel strategies, and to evaluate whether strategies actually prevent inappropriate gun carrying and use and reduce firearm-related injuries.

E.* Identify modifiable sociocultural and community factors that influence youth violence.

Most of the research about risk and protective factors for youth violence has been limited to characteristics such as behavior and attitudes of the youths themselves or of their families. A significant gap in knowledge exists about the role of the larger social environment in youth violence and its prevention. For

example, while the strong negative association between socioeconomic indicators and youth violence is well documented, little is known about the mechanisms linking low socioeconomic status to youth violence. Understanding these mechanisms will be extremely important in improving existing community programs and developing new programs for low-income communities. Other sociocultural and community factors that require greater research attention include the role of illicit drug markets, the nature and quality of public housing, the role of formal and informal social networks, the role of social norms, and the relationship between social capital and community rates of youth violence. Research should also examine the interaction between physical and social environments and assess how modifications in the physical environment influence behavior and risk for violence.

Certain communities are disproportionately affected by youth violence. By addressing factors in the larger social and physical environments, interventions will be better able to reduce the racial, ethnic, and social disparities for youth safety that exist in many communities. This work has important implications for policies designed to reduce injury and adverse health outcomes other than youth violence. It also is an area of research that is not currently being addressed by other funding agencies but that is directly relevant to CDC's focus on community and population-based health.

F.* Identify modifiable factors that protect youths from becoming victims or perpetrators of violence.

Research about factors that buffer or moderate the effects of risk factors for youth violence is very important to the development of effective prevention strategies. To date, research about the causes of youth violence has been focused almost exclusively on understanding factors that place children and youths at greater risk for violence. While researchers have made substantial progress in identifying risk factors, a significant gap remains in understanding the factors that mitigate risks.

Improved understanding of protective factors has immediate implications for youth violence prevention efforts in schools and communities.

Improved understanding of protective factors has immediate implications for ongoing youth violence prevention efforts in schools and communities. For example, as information becomes available about how parents in low-income communities can protect their children from violence, it can be immediately communicated through existing parenting programs and public service announcements. Research about modifiable protective factors has important implications for prevention and is not being addressed elsewhere.

G.* Clarify the relationships between youth violence and other forms of violence and determine implications for prevention.

Research has consistently shown that different forms of violence—that is, child maltreatment, intimate partner violence, youth interpersonal violence, and suicide—are interrelated. For example, victims of early child maltreatment may become perpetrators of violence later in life. Another example emerging from recent acts of violence in school settings suggests that being a victim of bullying and violence may be a risk factor for suicidal behavior and violence perpetration. Most prevention strategies focus on specific forms of violence or other health-risk outcomes. Because many school-based violence prevention specialists are seeking programs with fewer individual curriculum modules and more integrated approaches to youth risk behavior, prevention strategies that are effective in multiple areas could be very valuable.

Research about the relationships among various forms of violence can guide the development and evaluation of prevention programs that reduce multiple forms of violence.

The Injury Center’s experience studying suicide, family violence, and youth violence provides a unique environment for understanding the shared and independent factors that contribute to the different forms of violence. Research about the relationships among various forms of violence can guide the development and evaluation of prevention programs that reduce multiple forms of violence. Efforts to include multiple forms of violence in studies of risk and protective factors or evaluation studies are urgently needed to improve researchers’ understanding

of the specificity of youth violence prevention strategies and the ability to generalize their results. Given the limited funding available to prevent youth violence, strategies should address multiple forms of violence whenever feasible.

H. Examine strategies for and benefits of adapting prevention programs for specific cultural or gender-defined groups.

Prevention programs may require modification to be effective with groups other than the original target groups for whom the programs were designed. Research should test ways to adapt programs to strengthen their impact within various groups. Such research can provide useful operational definitions of cultural issues and identify limits for generalizing youth violence prevention programs across subgroups of the population. Research should identify strategies for overcoming limitations and for maximizing the impact of scarce prevention resources. The knowledge gained from this research will likely be relevant to other violence- and injury-related prevention efforts.

I. Assess the cost-effectiveness of youth violence prevention programs and their components.

Prevention science should be accountable and responsive to public health issues, and so it is necessary to evaluate not only the effectiveness of programs, but also the cost to the public to implement those programs on a broad scale. In programs with more than one component (e.g., classroom curricula, media campaigns), information about the costs, required resources, and relative contribution of individual components could be used to improve program efficiency. Researchers should build on ongoing effectiveness research and test new methods for determining the cost-effectiveness of prevention programs.

Research should investigate how to develop effective messages and how to identify the most appropriate audiences and venues for campaigns.

J. Develop and evaluate media-based public health strategies to prevent youth violence.

Prevention strategies that incorporate a broad array of media and are based on a public health approach to violence prevention may influence the behaviors of large audiences of youths and/or families. Research should investigate how to develop effective messages and how to identify the most appropriate audiences and venues for campaigns. Prevention campaigns serve two goals—to convey prevention messages directly to their audiences and to provide information about available programs. Both outcomes should be evaluated. The results of these evaluations will likely be relevant to similar strategies for preventing other forms of violence and other injuries.

K. Evaluate the impact of public policy on youth violence.

Researchers should study the effects of broad policy shifts, such as welfare reform, as well as policies directed specifically at youths, such as curfews. The specific policies evaluated will depend on the types of policies that emerge from federal, state, and local agencies. This policy research can be applied to a range of violence-related outcomes and will likely have relevance beyond youth violence prevention.

L. Evaluate how violence portrayed in the media affects youth violence.

Little consensus exists on the influence of various forms of media—including television, film, radio, music, print, and the Internet—on the risk for violent victimization or perpetration, especially severe forms of violence. Because of the pervasive presence of the media, developing methodologically sound approaches to evaluate its influence and building consensus on these approaches are important activities. The results of such research should inform policies and programs to decrease youth susceptibility to violence portrayed in the media.

M. Evaluate the impact of directly witnessing violence on violent behavior.

A relatively large subgroup of youths has witnessed violence. A better understanding of the consequences of exposure to violence will help guide programs designed to support these youths. Research should examine how exposure to violence affects the risk of perpetrating violence, including the potential for contagion effects (e.g., learned response, imitation), with the goal of identifying factors that may reduce the impact of witnessing violence. It should also investigate the effect that witnessing violence has on young people's perceptions of vulnerability, attitudes and norms about violence, and emotional and social health.

N. Identify situational factors that contribute to incidents of violence.

Researchers know relatively little about how the factors immediately associated with an incident of violence, such as the behavior of bystanders, the lack of adult supervision, the presence of alcohol or weapons, and other physical factors, interact with individual-level factors to influence risk for violent behavior. Research should build upon information about the circumstances under which interpersonal conflicts are most likely to result in injury or death. The results of this research should be incorporated into existing prevention efforts and help generate novel strategies to address situational factors.

O. Increase the understanding of violent behavior and victimization among young women.

Research should identify the causes of violence and victimization among young females; examine patterns of perpetration over the female life course; and develop and evaluate interventions intended for young females. Interventions should be sensitive to cultural variations in the risk factors for violence among this population.

When it is appropriate in ongoing research, the Injury Center will test for gender differences in the risk and protective factors studied and gender-specific effects of the prevention strategies tested. Although females are included in these other etiologic and efficacy studies, it is important to consider the unique needs of females who are at risk for being victimized or victimizing others. As the results from other research indicate that specific gaps remain in the knowledge about gender differences, this line of research may be given a higher priority.

Acute Care, Disability, and Rehabilitation

Public Health Burden

The most favorable patient outcomes result when acute care and subsequent rehabilitation begin as early as possible and when they focus on returning patients to their baseline or an optimal level of functioning.

Each year, Americans make 30 to 40 million emergency department (ED) visits for injuries. While the majority of injured patients are treated and released, many are admitted to inpatient trauma units and later receive rehabilitative services. The most favorable patient outcomes result when acute care and subsequent rehabilitation begin as early as possible and when they focus on returning patients to their baseline or an optimal level of functioning. Trauma systems are designed to match trauma patients with the acute care and rehabilitative facilities they need, but in many parts of the United States, trauma systems are not fully operational or do not exist at all. Where these systems are lacking, as many as 30% to 40% of deaths among trauma patients are due to preventable problems in clinical care, including missed diagnoses and treatment delays. Follow-up studies have shown as much as a 50% reduction in preventable trauma deaths after trauma systems are introduced.

Injuries are a major cause of disability in the U.S. Central nervous system injuries—those to the brain and spinal cord—are most likely to result in serious, long-term disability. Each year, an estimated 80,000 Americans sustain traumatic brain injuries (TBI) that result in disabilities; an estimated 5.3 million Americans live with TBI-related disability. Although physical impairments from the injury may contribute to TBI disability, cognitive deficits are the hallmark, frequently resulting in secondary conditions such as depression and other adverse outcomes such as the inability to work. An estimated 200,000 people in the U.S. live with spinal cord injuries (SCI), and this number increases annually by as many as 20,000 individuals. Secondary conditions such as pressure ulcers are a common cause of lost productivity among people with SCI.

Other important disabling injuries include limb injuries, back injuries, eye injuries, and burns. Injuries to the lower extremities constitute the leading cause of trauma admissions among adolescents and young adults, accounting for 235,000 hospitalizations each year. In addition to their high incidence, lower extremity injuries often result in significant impairment and loss of function.

Injured patients may suffer a variety of psychosocial effects, including post-traumatic stress disorder, depression, misuse of alcohol and other drugs, and difficulties returning to the routines of pre-injury work and social lives. Screening and intervention programs may reduce the frequency and severity of these consequences and may also decrease the number of ED and trauma center visits for future injury. In one study, for example, screening and intervention for alcohol problems among patients hospitalized for trauma reduced hospital admissions for injuries by 48% for the following three years. To prevent adverse outcomes, pre-existing injury risk factors, such as excessive alcohol use, must be addressed in a comprehensive way, including during acute care and rehabilitation.

The Injury Center's Niche in Acute Care, Disability, and Rehabilitation

CDC's Injury Center maintains close ties with practitioners and researchers working in acute care and rehabilitation, as well as with public health professionals working in injury prevention and control. These relationships help foster cooperation and strategically advance a broad-based, multidisciplinary approach to injury. The Injury Center's multidisciplinary orientation also provides unique opportunities to catalyze and coordinate innovations in clinical preventive services in acute care and rehabilitation facilities. It recently developed a research program on clinical preventive services for alcohol problems in EDs and brought together federal partners and experts in alcohol research, emergency medicine, and trauma care to set a research agenda for this emerging field.

The Injury Center's partnerships with state health agencies, academic injury research programs, and health care practitioners provide a vital foundation for establishing and maintaining population-based surveillance systems and conducting outcomes research. More comprehensive and timely information about injury incidence, causes, and outcomes in defined populations can help guide injury prevention programs as well as efforts to improve treatment and rehabilitation for those injuries that do occur. With its focus on population-based surveillance and research, the Injury Center is positioned to lead the development and dissemination of appropriate case definitions, data elements, and data collection methods. Activities involving evaluation of community- and clinic-based interventions, community services, and systems of care also distinguish the Injury Center's work from that of many other agencies.

CDC's Injury Center maintains close ties with practitioners and researchers working in acute care and rehabilitation. These relationships help foster cooperation and strategically advance a broad-based, multidisciplinary approach to injury.

Although lead federal responsibility for trauma care systems resides with the Health Resources and Services Administration (HRSA), the Institute of Medicine (IOM) report *Reducing the Burden of Injury: Advancing Prevention and Treatment* specifically recommends that the Injury Center collaborate on new trauma outcomes research. The Injury Center staff has extensive experience working with public and private sector organizations responsible for trauma care system planning and development at the local, state, and national levels. This experience positions the Injury Center to help set research priorities, provide technical assistance for research programs, and facilitate translation of new findings into practical methods for evaluating trauma care systems.

The Injury Center's research and programs in the area of disability and rehabilitation are designed to inform efforts to reduce the impact or prevent the development of secondary conditions and other adverse outcomes of TBI and SCI. Findings from Injury Center-funded TBI surveillance provide crucial information to guide primary prevention efforts, not only for TBI but for many other injuries as well.

Many of CDC's injury research activities can support the work of other federal, state, and local agencies. The Injury Center collaborates with agencies involved in trauma care and disability prevention, including HRSA, the National Institute for Disability and Rehabilitation Research (NIDRR), the National Center for Medical Rehabilitation Research at the National Institutes of Health, and the Social Security Administration. All research activities should include interaction among related organizations and agencies to develop case definitions and enhance the ability to generalize across agencies' studies.

The Injury Center's Research Priorities in Acute Care, Disability, and Rehabilitation

Every research priority in this agenda is important. After considering input from experts in the field, Injury Center staff identified the eight most important priorities, those that warrant the greatest attention and intramural and extramural resources from the Injury Center over the next three to five years. They are designated with asterisks.

Priorities

A.* Develop and evaluate protocols that provide onsite interventions in acute care settings or linkages to off-site services for patients at risk of injury or psychosocial problems following injury.

Clinical preventive services for patients treated in emergency departments, hospital trauma units, and other acute care settings can help reduce the risk of injury and mitigate the effects of injuries that do occur. Such services might include instruction in the proper use of safety restraints and screening and interventions for alcohol problems, intimate partner violence, or child maltreatment. For injured patients, ED visits and inpatient hospital admissions for trauma care may provide crucial opportunities for early identification of and intervention for post-traumatic stress disorder and other psychosocial problems that can follow or be exacerbated by injury.

Clinical preventive services for patients treated in acute care settings can help reduce the risk of injury and mitigate the effects of injuries that do occur.

Decision makers are often reluctant to fund preventive clinical services because they believe the investment needed to implement a single service in one clinical setting is too high. Research should demonstrate the effectiveness and value of such services and examine ways to implement multiple services simultaneously to amortize operational costs.

B.* Measure the benefits and costs of trauma care systems.

Despite evidence that trauma care systems save lives, many areas of the U.S. lack trauma system coverage. New methods of measuring morbidity, quality of life, functional status, and cost will help define the benefits and costs of trauma care systems, including determining which patients benefit most from trauma care systems and at what costs. In all aspects of trauma care, these new approaches to studying outcomes and costs will likely yield insights that influence policies and practices at the national, state, and local levels. They can be applied in ongoing efforts to monitor and improve system performance and may be useful in research conducted about specific clinical interventions.

C.* Identify risk factors and develop and evaluate interventions for secondary conditions following TBI or SCI, particularly among patients who have not received treatment or rehabilitation at state-of-the-art facilities.

Secondary conditions of TBI and SCI result in reduced capacity to perform daily activities, lost work productivity, and decreased quality of life. Secondary conditions range from medical conditions resulting from the injury, such as pressure ulcers among people with SCI, to behavioral changes, such as alcohol and substance abuse. Much of the research about the incidence and risk factors for secondary conditions of TBI and SCI has been conducted by researchers from NIDRR's Model Systems project, which focuses on a relatively small subgroup of patients treated by specialized Model Systems facilities. Research should increase understanding about the risk factors for secondary conditions among all persons with TBI and SCI, especially those who do not have access to state-of-the-art information and care.

The relationship between treatment for secondary conditions and longer-term outcomes of TBI and SCI is not well understood. Additional research is needed to develop more effective rehabilitation methods that include treatment or management of secondary conditions and to evaluate the costs and benefits of these approaches.

D.* Identify methods and strategies to ensure that people with TBI and SCI receive needed services.

People disabled by an injury often do not receive the help they need. A CDC-funded follow-up study of TBI in Colorado found that one year after injury, about one third of people with a disability said they had not received any services since their discharge from the hospital. According to a 1998 General Accounting Office report, people who have cognitive or behavior problems, but not physical problems, resulting from TBI are among those most likely to have unmet service needs. Without treatment, people with behavior problems are the most likely to become homeless, be committed to mental institutions, or be

Research should increase understanding of the gaps between needed and available services for people with TBI and SCI and should identify strategies to close those gaps.

sentenced to prison. A recent study showed that people with TBI who received the services they needed reported a better quality of life. Research should increase understanding of the gaps between needed and available services for people with TBI and SCI and should identify strategies to close those gaps.

People with “mild” TBI may not even be diagnosed with a TBI, making it even more difficult for them to get assistance. Research should explore the possibility of adapting case identification methods to help link people with TBI and SCI to services. To that end, the Injury Center has already funded two small, pilot projects to investigate the feasibility of using state-based TBI surveillance to identify people hospitalized with TBI who may need help finding out about services. Studies should investigate specific methods for linking people to information and services, such as evaluating the usefulness of toll-free telephone numbers that serve as single points of entry to the service delivery system. Studies should also describe the spectrum of rehabilitation services and trends in service provision, and they should evaluate access to medical, rehabilitation, and social services to prevent disabling outcomes and secondary conditions.

E.* Develop and evaluate methods of using point-of-care clinical information systems to report injuries and other acute health problems to public health agencies.

As electronic clinical information systems enter the mainstream of acute care practice, new opportunities arise to use clinical data for public health surveillance of injuries and other acute health problems. However, methods of using point-of-care clinical information systems in this manner are not well developed and require evaluation. Research should identify the point-of-care data to be recorded and reported, resolve questions about terminology and classification systems, guide decisions about linking disparate systems, and evaluate the benefits and costs of new approaches to public health surveillance of injuries and other acute conditions. Findings from this research can help establish and maintain

relevant data standards. For example, in emergency and trauma care, standards would include data elements, clinical vocabularies, and coding systems that convey information about the nature, severity, treatment, and outcomes of injuries.

Point-of-care clinical information systems can facilitate surveillance of access to acute care. Diversions of patients transported by ambulance have increased in recent years in many metropolitan areas in the U.S. When a hospital places its emergency department on diversion, patients transported by ambulance must be taken to another hospital for emergency care. Prolonged patient transports and resulting treatment delays cause dissatisfaction among patients, practitioners, and health care managers. They also may lead to worsening clinical outcomes. More systematic and population-based research is needed to evaluate the impact of diversions on patient care in defined geographic areas. Research about emergency department diversions can be aided by Web-based reporting systems that enable hospitals to communicate their diversion status to other hospitals and to health agencies. Linking data from these systems to patient outcome data can provide an important measure of the magnitude and consequences of ambulance diversions.

F.* Develop and apply methods for calculating population-based estimates of the incidence, costs, and long-term consequences of SCI and nonhospitalized TBI.

Developing methods to identify and characterize people with TBI and SCI is an essential first step to conducting surveillance and outcome studies. Such methods are lacking for some subgroups of people with TBI, particularly those with “mild” TBI. Research should focus on increasing uniformity of case identification methods to improve the comparability of national-level data for people with TBI. Increased collaboration among federal agencies is crucial to such research. Considering available resources and the language in the TBI Act Reauthorization for 2000, case identification of people with “mild” TBI, including those who do not receive medical care, should receive highest priority.

Case identification of people with “mild” TBI, including those who do not receive medical care, should receive highest priority.

The Injury Center conducts population-based surveillance to develop nationally representative estimates of the incidence, prevalence, nature, and causes of injuries that result in long-term disability. This activity includes conducting population-based follow-up studies to identify and track the long-term outcomes of disabling injuries. Research should investigate the unique outcomes and special needs of specific subgroups of TBI and SCI populations, such as those injured as a result of violence. Better information about outcomes could improve estimates of the true burden of disability for individuals with “mild” TBI by helping to document long-term problems resulting from these injuries. Research should also identify the service needs of people with TBI and SCI, providing useful information for injured persons, service providers, and policy makers.

The direct medical costs and indirect costs associated with disabling injuries are not well documented; however, this information is important to guide decisions about resource allocation and other policies. For TBI, the study most often cited was published 10 years ago. Research should provide comprehensive, up-to-date information about the direct and indirect costs of TBI and SCI. In addition, research should estimate the costs associated with secondary conditions such as pressure sores, depression, and alcohol abuse.

G.* Determine the impact of TBI on special populations.

The majority of population-based studies of TBI outcomes have focused on adults generally. Documenting the true impact of disability from TBI requires additional research on populations that have not been well studied to date, including children and youths, working adults, institutionalized individuals, victims of intimate partner violence, and people within school systems and the criminal and juvenile justice systems. Some subgroups within the adult TBI population, for example people in prisons, are difficult to locate and are often lost to follow-up. Considering available resources and language in the TBI Act Reauthorization of 2000, determining the prevalence of TBI and related disability among children, youths, and people in institutions should receive highest priority.

H.* Determine the incidence, causes, nature, biomechanics, and outcomes of limb injuries.

The few studies to date about limb injuries have shown that these injuries result in substantial disability and affect one's ability to return to work. In fact, only about 50% of people who were working before being injured return to work within six months. The extent of physical impairment is one key factor that influences disability, but other factors exist about which data are limited. Research using population-based studies is needed to describe accurately the public health burden of limb injuries and to suggest appropriate interventions to prevent these injuries and resulting disability. In addition to epidemiologic studies, research about the biomechanics of injuries to the extremities, such as fractures and dislocations, is necessary to devise prevention strategies.

I. Develop and evaluate interventions to improve patient safety in health care settings using strategies that have helped prevent and control injuries.

The IOM report *To Err is Human: Building a Safer Health System* has spurred new efforts to monitor and improve patient safety. The report highlights injuries in health care settings that are amenable to systematic surveillance, epidemiologic study, and targeted interventions to prevent them or control their effects. Although the Injury Center is not a lead federal agency for efforts to improve patient safety, its expertise and experience in developing, disseminating, and evaluating countermeasures for a wide range of injury problems provides a powerful injury-prevention paradigm appropriate to the problem. For example, much has been learned about preventing falls and suicides in community settings that can be extended to health care facilities. The Injury Center's partnerships with professional associations, community groups, national coalitions, prevention specialists, injury researchers, and state and federal health agencies will be advantageous in building support for and disseminating interventions to improve patient safety.

An IOM report highlights injuries in health care settings that are amenable to systematic surveillance, epidemiologic study, and targeted interventions.

J. Develop and evaluate interventions for reducing disability due to “mild” TBI.

People with “mild” TBI, especially those who are not hospitalized, frequently receive little information about the potential impact of their injuries and may not even be diagnosed by health professionals. Some clinical psychologists report that early counseling and intervention can reduce the likelihood of long-term problems. For example, early training in adaptive strategies to cope with memory problems may minimize an injury’s impact. Identifying appropriate interventions and documenting their effects will support the development of a service infrastructure for people with “mild” TBI.

K. Develop and evaluate injury and disability interventions using biomechanical and computer models.

Knowledge of injury tolerance and injury mechanisms for the most prevalent and disabling injuries among children and adults of different sizes should be applied to the design of injury and disability prevention strategies. These strategies should be evaluated using biomechanical models, “crash dummies,” and computer simulation and models.

L. Determine how the environment affects disability from TBI and SCI.

Physical and social factors in the environment may contribute to the risk of disability among people with TBI and SCI. According to the 1991 IOM report *Disability in America*, physical risk factors are primarily the product of the built or human-made environment, for example, the lack of stair ramps or inadequate transportation. Social factors are a function of the opportunities and expectations that may interfere with a person’s ability to get a job; the presence of discriminatory attitudes about the capabilities of people with disabilities is one example. The relationship between these factors and disability among people with TBI and SCI has not been well studied.

M. Investigate the long-term effects of TBI and SCI on the health and longevity of people with disability from these injuries.

Early research suggests that people with disabilities may have shorter life spans and poorer health overall as they age than do people without disabilities. Specific research about the relationship between injury-related disability and long-term health effects is needed to guide interventions to reduce the likelihood of these adverse outcomes as persons with disabilities age. Research should include longitudinal studies of people with TBI- and SCI-related disabilities, as well as studies of older adults who sustain these injuries.



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